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

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

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
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Petitioners,

vs.) No. IPR2016-00747

ACCELERATION BAY LLC,

Patent Owner.

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.

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Menlo Park, California; Tuesday, February 7, 2017
9:34 a.m.

THE VIDEOGRAPHER: Good morning. We are on the record at 9:34 a.m. on February 7th, 2017. This is the video-recorded deposition of Dr. Harry Bims. My name is Dustin Brown. I'm here with our court reporter, Catherine Ryan. We are here from Veritext Legal Solutions at the request of counsel for Petitioners. This deposition is being held at 990 Marsh Road in Menlo Park, California. The caption of this case is Activision Blizzard, Incorporated, et al. versus Acceleration Bay LLC. Case number is IPR2016-00747.

Please note that audio and video recording will take place unless all parties agree to go off the record. Microphones are sensitive and may pick up whispers, private conversations, and cellular interference.

I am not authorized to administer an oath. I am not related to any party in this action, nor am I financially interested in the outcome in any way.

If there are any objections to proceeding, please state them at the time of your appearance, beginning with the noticing attorney.

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MR. TOMASULO: Michael A. Tomasulo from the law firm of Winston & Strawn. With me is my associate David Lin and in-house counsel for Electronic Arts, Inc., one of the petitioners, Paul Main, also a California barred attorney.

We are here on behalf of the three petitioners -- or all of the petitioners identified in the proceeding.

MR. HANNAH: James Hannah from Kramer Levin, representing Acceleration Bay and the witness, and with me is Stephanie Nguyen.

THE VIDEOGRAPHER: Thank you. The witness will be sworn in, and counsel may begin the examination.

HARRY BIMS, Ph.D.,
having been administered an oath, was examined and testified as follows:

EXAMINATION

BY MR. TOMASULO:

Q Good morning, Dr. Bims.
A Good morning.
Q You realize you're under oath?
A Yes.
Q You've had your deposition taken before, yes?
A Yes.
Q Any reason that you can't give true and correct testimony today?
A No.
Q Okay. You understand you have the obligation to tell the truth, the whole truth, and nothing but the truth, right?
A Yes.
Q And -- and that means if you can't understand something, will you let me know?
A Yes.
Q And if you answer a question without saying "I don't understand you," the record will reflect that you understood and answered the question, right?
A Yes.
Q Now, do you consider yourself qualified to offer expert testimony on the matters on which you have opined in your declaration?
A Yes.
Q Anything in that declaration -- now, you signed that declaration, and you understood it when you signed it, right?
A Yes.
Q And is there anything that has caused you to change your testimony?
A There was one paragraph in which there was a mistaken name given in that paragraph that I had noticed --
Q Okay.
A -- when I reviewed my deposition -- my declaration the other day.
Q Okay. We'll get to that.
Anything else besides that one --
A No.
Q -- mistake? Okay.
And you attached your CV to that declaration, right?
A Yes.
Q And was -- when you attached that, it was complete and accurate?
A Yes.
Q And do you maintain a LinkedIn biography or some kind of a LinkedIn account as well?
A Yes.
Q And is that accurate?
A Yes. For the most part, yes.
MR. TOMASULO: I'd like to mark as -- let's call it -- do you -- are you starting just at 1? Is that how you did it with Carter, or did you

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start with, like, 3000 or anything like that?
MR. HANNAH: I believe we just started at 1.
MR. TOMASULO: Okay. So we'll just mark this as Bims Exhibit 1, and that will be your CV.
(Exhibit 1 was marked for identification by the court reporter.)
BY MR. TOMASULO:
Q And did you prepare this, Exhibit 1, your CV?
A Yes.
Q Okay. And it has something called Bims Laboratories, LLC. What is Bims Laboratory?
A It's a company that I started a few years ago within which I do a number of research projects in the area of networking.
Q Okay. Is that company still ongoing?
A Yes.
Q When was the last -- it looked to me like the last project that's listed under Bims Laboratories ended in -- ended in 10/2009. Is -- are there other projects or am I misreading this?
A Well, what it says here on page A-3 is that there's an ongoing effort in the 802.16 working group in which I have a number of leadership

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positions starting in October of 2009 and to the present.
Q Okay. Any other projects that are ongoing under the Bims LLC -- Bims Laboratories, LLC?
A Well, as part of that effort with that 802.16 working group, we -- we meet every two months alongside other working groups within the IEEE, such as the 802.11 working group. So in my capacity working for that working group, I'm also involved in the standardization efforts throughout the IEEE 802 committee's efforts, which includes standardization of WiFi technology, standardization of Ethernet technology in 802.3 personal area networking and 802.15, et cetera.
MR. HANNAH: Counsel, do you have an extra copy of the exhibit?
MR. TOMASULO: Oh. I'm sorry. Yeah, I do.
MR. HANNAH: Thank you.
BY MR. TOMASULO:
Q Is that a paid position that would -- that you've just described?
A My activities there are all volunteer.
Q Okay. When was the last time Bims Laboratories, LLC generated direct revenue from a

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third party or any revenue, for that matter?
A I'm trying to think because I have had some engagements that were to be considered confidential consulting arrangements, and I'm trying to remember the last time that occurred. That was a few years ago, probably at least -- at least five years ago.
Q Okay. So then, say, in the last five years has your work primarily been as a technical expert witness?
MR. HANNAH: Objection. Form.
THE WITNESS: Well, I would say in the last five years that most of my income has come from engagements as an expert witness.
BY MR. TOMASULO:
Q Okay. Any other income that you can think of in the last five years besides engagements as an expert witness, whether it be testifying or consulting?
A I would say all of -- all of the matters that have generated income have related to -- in one way or another to litigation activities.
Q Okay. You have something here that says: "Access network protocol development, technical lead developer." That's on page A-3.

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A Yes.
Q What is that?
A So that's an ongoing project which still is not complete to create a -- within one project an implementation of a wide variety of networking protocols, not only the networking protocols that I mentioned within the IEEE 802 committee, but also other protocols, such as what you would find in the 3GPP standard -- standardization organization as well in -- as in the areas of digital cable and -- and et cetera.
Q What is -- on the second line under "Technical Lead Developer" it says "Channel Model." What does that mean?
A Okay. So that line talks about the IMT 2020 channel models. There's an umbrella organization that looks to harmonize the various worldwide networking protocol standards in a common framework, and to that end there are a series of requirements that new standards efforts need to -- need to adhere to. And so in order to prove conformance to the harmonized requirements globally, the IMT 2020 channel models were developed as a common reference benchmark for testing various wireless protocols, such as LTE or 802.11 or 802.16,

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to make sure that their physical and RF layer performance is up to standard.
Q And what does the word "channel" mean in this context?
A So an IMT 2020 channel is a wireless channel.
Q And what does that mean? Does that mean that it's a type of point-to-point communication or it's a channel that multiple people can listen to like a broadcast? What does the word "channel" mean in this context? Can you elaborate a little?
MR. HANNAH: Objection. Form.
THE WITNESS: So the IMT 2020 channels are focusing on the modulation and demodulation of electromagnetic signals for communication between two nodes in a -- over a wireless medium. The wireless medium itself can be used for a variety of network topologies, including both point-to-point as well as point-to-multi-point technologies.
BY MR. TOMASULO:
Q So it can establish from one to one or one to many?
A Yes, both are possible in a wireless medium.
Q Okay. And how does that -- how does that

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form a connection between, let's say, just one to one? In a point-to-point connection for a channel model under the IMT 2020 standard, how is a connection established? Or is a connection established?
A So --
MR. HANNAH: Objection. Form.
THE WITNESS: So as I was alluding to earlier, the IMT 2020 channel models focus on the RF and physical layer performance of wireless networking protocols. Typically connections that are formed over the wireless medium occur at a higher layer in the protocol stack than what the IMT 2020 channel models are addressing.
BY MR. TOMASULO:
Q So the IMT 2020 doesn't actually facilitate a connection?
A No. The IMT 2020 channel models are modeling the RF and physical layer communication between two wireless nodes by setting the parameters for testing the -- the performance of a networking protocol in terms of its ability to communicate electromagnetic signals that are modulated with the RF and physical layer standards.
Q It can be -- the standard is used to

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communicate between two nodes, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Yes, typically a standard that is being tested according to an IMT 2020 channel model is a wireless standard, which means that, as part of that standards document, there will be a section that describes the RF modulation and demodulation of electromagnetic signals.
BY MR. TOMASULO:
Q You mention Bluetooth here. What's Bluetooth?
A So Bluetooth is a wireless standard that was developed in Europe and has since been incorporated into a U.S. standard within the IEEE 802.15 working group and is typically used for short-range wireless communications up to a range of about 30 to 50 feet.
Q And that can be used for point-to-point communication, right, when I use my Bluetooth on my phone to communicate with another Bluetooth device, right?
A Yes, that's possible.
Q And to do that there's a connection that's established between my phone and, let's say, my wireless speaker, right?

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MR. HANNAH: Objection to form.
THE WITNESS: Well, there are a lot of things going on in the Bluetooth standard. When the Bluetooth standard establishes a connection, it actually -- there are different types of connections that can be established. So based upon the context in -- in which the device is operating, a particular type of connection would be established with its own set of access procedures to establish that connection. But that's all well laid out in the -- in the document, which is thousands of pages long describing this procedure.
BY MR. TOMASULO:
Q So there's a protocol by which two devices establish a point-to-point connection; is that right -- or multiple protocols, perhaps?
A Well, the Bluetooth standard describes the protocol which performs a number of operations, and -- and one of those operations is to establish one of a variety of types of connections that are possible within the Bluetooth standard itself --
Q And that --
A -- or for communication of -- of video, audio, digital data, et cetera.
Q And that would be a point-to-point

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connection, right?
A It can be a point-to-point connection.
Q Are those connections that you mentioned -- are some of those not point-to-point connections when you talk about video or data or -- you listed several things. Are those not all types of point-to-point connections that are being used to exchange that type of data?
A So what I was describing were types of data that are communicated over a Bluetooth protocol, such as video data, audio data, digital data, each one of which has its own characteristics for communication and would require a different type of connection to be formed, and the Bluetooth standard, in an attempt to optimize the use of the wireless medium, has different procedures for establishing connections depending on the type of data to be communicated.
Q My question was would it be a point-to-point connection? That's my question.
A Well, it depends on the use case scenario. Within Bluetooth standard there's a section which describes a wide variety of use case scenarios all the way from the communication of a photo from one node to another to printers that are connected via

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Bluetooth. There are a wide variety of use case scenarios within which Bluetooth is envisioned to be used --
Q So --
A -- and not all of them are necessarily point-to-point communication scenarios.
Q Okay. So you identified two right here. One was where a -- was a communication to a printer from a phone; is that right? Just one?
A It could be a phone, yes.
Q Okay. So a phone to a printer establishes the Bluetooth connection. Would that be a point-to-point connection?
A I'd have to go back and look at that use case again, but within the universe of what's possible in Bluetooth, it's possible to establish point-to-point communication.
Q So if I use -- pull out my phone and you enable your Bluetooth, can we establish a point-to-point communication?
A That's possible depending on --
Q So --
A -- which application modes you invoked for using Bluetooth.
Q So, yes, we could?

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A It's possible, yes.
Q Okay. And so going to page A4, you have listed some of your work as an expert witness, along with your -- along with your clients.
Do you see that?
A Yes.
Q And so it says here that you were retained by your client, Kramer Levin, on 12/15. Is that correct?
A Yes.
Q And before 12/15 had you ever seen the -- any of the Boeing patents that you have offered testimony on?
A No.
Q And before 12/15 had you ever offered any testimony or given any expert opinions on matters involving video games?
A Not directly.
Q What does that mean, "Not directly"?
A Well, video game technology is really an application layer technology which uses underlying networking protocols to communicate between participants. So that extent the work that I have done throughout my career focuses on the -- the underlying networking technology which can be

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leveraged by a wide variety of applications, including online gaming technology.
Q Okay. Have you ever worked in a case where the accused device was a video game?
A Yes.
Q What -- which one?
A There was a litigation involving the CSIRO organization, C-S-I-R-O, versus about 30 co-defendants in which the CSIRO organization accused the co-defendants of infringing an 802.11 technology that was embedded in the products of the co-defendants. Some of those co-defendants included, for example, Microsoft, and the list of accused products included, for example, the Microsoft Xbox because that gaming console includes 802.11 technology.
Q Okay. So that was a case that was based on 802.11 technology, and some of the accused products -- one of the accused products was the Microsoft Xbox; is that right?
A That's the one that comes to mind, but, again, with 30 co-defendants, the list of accused products was quite extensive and covered a wide variety of 802.11 devices, including, as I mentioned, gaming devices.

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Q And in the context of that case did you study the Microsoft Xbox?
A So in the context of that case what I was asked to do was to focus on the 802.11 technology embedded within all of these products, and that's really where I focused.
Q Okay. But my question was different.
Did you study the Microsoft Xbox or not?
A Only to the extent that I studied the 802.11 technology embedded within the Xbox.
Q Did you ever physically touch a Microsoft Xbox in that case?
A I don't think that I did, no.
Q Okay. Other -- so other than that, has any of your testimony involved video games directly?
A Not that I recall.
Q Okay. And in the Finjan case you have testified for Kramer Levin as your client there. In September 2015 to the present you were engaged in that matter; is that right? This is on page A-5.
A Yes.
Q And did you offer any opinion on infringement or non-infringement or validity there? It looks like it was only a tutorial.
A Correct. I only offered a tutorial to the

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court to explain network security -- security technology, without rendering any opinions on the question of infringement or validity.
Q Okay. And then your next case here you worked for Microsoft in an inter partes review proceeding. And I imagine you were testifying that the patent was invalid; is that right?
A Yeah, I did submit declarations in that case in support of the petitioner.
Q Okay. And then the next case here is for your client Reed & Scardino, LLP, and it says you were a testifying expert and you offered testimony on infringement; is that right?
A Yes.
Q And how did you reach the conclusion -- what did you do before you reached your conclusion of infringement in that case in terms of what did you look at? Did you look at source code? Did you look -- did you test the device? Did you listen to deposition testimony? Did you see design documents?
A So in that -- excuse me. In that case there were a number of patents asserted in that case, and so my -- my role in the case was to review the patents and file history and then to review the technical documents that were disclosed in that case

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by Amazon that describe in detail the operation of the networking system that they have created. In addition, I reviewed a number of depositions of various Amazon employees, and as well I reviewed the expert report from the -- Amazon's technical expert as well as the claim construction order that was issued by the judge in that case, and putting together all of the information that I -- that I reviewed, I created my own expert reports, which I submitted in the case regarding the question of infringement.
Q Did you review source code in that case?
A Yes, there was some source code that I reviewed.
Q Okay. Did you rely on the source code to form your opinion of infringement?
A I relied on everything that I reviewed in order to reach the opinions that I had in the case, including source code.
Q So to form your infringement of -- to -- I'm sorry.
To form your opinion of infringement, you relied on the materials you described, which included confidential design documents and source code and depositions, correct?

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A Correct, I looked at those things and more in reaching my opinions.
Q Okay. Did you do any testing?
A In what sense?
Q Testing the network, testing the device.
A Well, certainly the asserted patents in that case had a number of claims which were asserted in the case, and as I reviewed the materials that were before me, in light of the asserted claims, I had to mentally step through each and every claim element and each word in the claim and at least mentally test whether or not the evidence that I'm reviewing proves or disproves infringement.
Q Other than mentally testing it, did you test the operation of the device or the accused system or the accused network?
A I did not have physical access to the Amazon network other than interacting with it the way any end user would interact with the network.
Q Okay. And then your next listing -- I'm sorry.
Going back to your testimony here, did you attempt to interact with the network in the way any other end user would interact with a network to form your opinion of infringement? In other words, did

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you operate the network to try to form your opinion of infringement in the case against Amazon?
A For at least one of the claim elements I did have to operate the user interface to the package delivery notification system in order to test whether or not the system was performing the -- the steps called for in that part of the claim.
Q Okay. And that was a test, then, right?
A Yes.
Q Okay. Your next listing is, again, for your client Kramer Levin, and this is another -- is this just another tutorial that you gave? If you answer "yes" or "no," it will keep things moving along.
A Yes, this is another case in which I offered a tutorial to the court on security technology without reaching any opinions on the question of infringement or validity.
Q Okay. And then in the next case it's again for your client Reed & Scardino, and that's as -- that's the same -- is that the same set of patents that were -- more or less the same set of patents that were asserted against Amazon? This is a case against BlackBerry.
Do you see that? It's on page A-7.

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A Yes --
Q Okay.
A -- I see that.
Q And in this case did you rely on the -- as in the Amazon case, did you rely on confidential design documents, source code, and deposition testimony and testing in forming your opinion on infringement?
A Yes, I did look at a wide variety of things.
Q Including those things that I just identified, right -- those four things?
A For the Research in Motion system I believe the -- as I recall, the user interface to the system was not a claim element, and as such I did not perform physical testing of the system.
Q Okay. So you just -- in that case there was no need to do physical testing so -- but you relied on confidential design documents, source code and deposition testimony, right -- in forming your opinion of infringement?
A As well as the Markman order of the court and expert reports from their witnesses at Research in Motion.
Q Okay. And then the next case is, again,

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for your client Reed & Scardino, again involving Mobile Technologies, this one versus UPS, and here you offered expert reports regarding infringement.
Do you see that?
A Yes.
Q And in that case did you rely on those same four things: confidential design documents, source code, deposition testimony, and physical testing?
A For this case I did not perform physical testing of the UPS system.
Q Okay. So -- but you did rely on the other three items -- the source code, the deposition testimony, and the confidential design documents -- right?
A As well as, you know, the Markman order of the court and the expert reports from the experts for UPS.
Q Okay. And that was a case involv- -- what was the general technology of all three of those cases? It says packet delivery and notification. Is it a business method patent, or is it a wireless technology patent, or -- in a couple of sentences can you explain what that technology was that was accused?

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A So the general technology space was networking technology, which included wired and/or wireless components of the network itself, and it involved the use of those underlying networks to -- to perform the application of package delivery and notification.
Q Okay. This is a case involving networking?
A Not just networking per se, but the use of that -- those networking protocols for the deployment of an application such as package delivery notification.
Q Okay. Next case is for Fish & Richardson, representing Samsung.
Do you see that?
A Yes.
Q I'm not clear what you did here. Did you -- you did not offer an expert report?
A That's -- that's correct.
Q And the case settled before that?
A Yes.
Q Had you reached an opinion on infringement or non-infringement at the time the case settled?
A No.
Q Okay. The next one is in a case where you

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were representing the plaintiff ZTE -- I'm sorry. You were representing -- your client was Brinks, Gilson on behalf of ZTE Corporation; is that right?
A Yes.
Q And you were testifying in an IPR proceeding there regarding validity, and so you were testifying on behalf of the patent owner, I suppose; is that right? Or were you testifying on behalf of the petitioner? It's not really clear to me.
A I was testifying in support of ZTE's positions in that case.
Q And was ZTE the patent owner or were they an accused infringer?
A The -- ZTE was the one issuing the IPR; so they were the petitioner, not the patent owner.
Q So the -- you were opining that the patent was invalid?
A Correct.
Q Okay. And your next case is for your client Kramer Levin. Who is your principal point of contact at Kramer Levin? Was that Paul Andre in this case -- this Sirius case?
A Yes, Paul Andre and James Hannah were two people that I worked closely with in that case.
Q Okay. And in this case you were

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representing the defendant?
A Yes.
Q And you provided an expert report on non-infringement?
A Yes.
Q And in that case what -- did you -- did you look at source code before perform- -- before -- let me try again.
Did you look at source code before forming your opinion of non-infringement?
A No.
Q Did you look at deposition testimony before performing -- before forming your opinion of non-infringement?
A I may have. I know I spent a fair amount of time reviewing the documentation -- the technical documentation of the system operation as well as a fair amount of time interviewing the engineers at SiriusXM to understand directly from the people who design and built the network how it actually works.
Q Got it. And you did that before you formed your opinion of non-infringement?
A Yes.
MR. HANNAH: Bless you.
//

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BY MR. TOMASULO:
Q Your next case is not a patent case. It's for Seyfarth Shaw. It's an employment case. Does that have anything to do with source code, patents, anything like that?
A So in that case there was a patent involved. The patent was co-assigned to the plaintiff in that case, the University of Florida Research Foundation and Rapid Mobile Technologies and the individual inventor who -- in this case the individual inventor filed an employment law case that related to the patented inventions, and I was asked to opine in that case on the question of infringement.
Q Okay. And so the next case is another case for Reed & Scardino again involving the Mobile Telecommunications Technologies, LLC. This one is against Clearwire Corporation.
Do you see that?
A Yes.
Q Okay. And this appears that you provided a report regarding validity.
Did you also provide any opinions on infringement?
A No.

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Q So you were retained solely for validity?
A Yes.
Q The next case is for Foley & Lardner, was your client, and testifying expert in a case involving mobile device testing systems.
Do you see that?
A Yes.
Q And had you reached any opinions in that case regarding infringement or non-infringement?
A I did have a declaration concerning the claim constructions in that case, but before the case proceeded to the point where I offered any opinions on the question of infringement, the case settled.
Q Okay. And then the next one is a Wilmer Hale case for Broadcom, and that was an IPR; is that right?
A Yes.
Q Okay. And then the next case here is for Kilpatrick & Townsend, and you're representing Google or they're representing Google and Motorola Mobility there; do you see that?
A Yes.
Q And then this is involving smartphone technology --

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A Yes.
Q -- is that right?
A Yes.
Q And then you gave a declaration in support of a motion for a protective order?
A Yes.
Q And what was -- what did you opine there or what was your declaration? What was the substance of that?
A I'm trying to remember, but at the time the accused products were products that were manufactured by Motorola Mobility, and I think there was some issue as to whether or not certain documents should be covered under a protective order, and I had to give an opinion on that. That was a very short declaration.
Q And I think -- and it's your opinion, right, that -- you know, that evidence of how a particular function is performed in a product is typically contained within most, you know, seven or eight files of source code, right? That's your general experience?
MR. HANNAH: Objection to form.
THE WITNESS: It depends on a number of factors. Generally speaking, when I do source code

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review, I'll look at quite a bit of source code. You know, typically it's at least a hundred thousand lines of code that I'll have access to in my reviews, typically, before reaching an opinion.
BY MR. TOMASULO:
Q So is it or is it not your general experience that evidence of how a particular function is performed in a product is typically contained within, at most, seven or eight files of source code?
A It's hard to give a signal number on that because the circumstances are very different from one case to another in terms of the complexity of the function as well as the way in which the accused functionality was actually implemented in the source code. From one developer to another, one developer may implement a function in one file, and then another developer may use several files to implement the same function. So there are a lot of variables at play, and it's -- it's hard to give a single number that's universally true across all -- all code and all functions in -- in --
Q I'm sorry. But my question was is it or is it not your general experience that evidence of how a particular function is performed in a product

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is typically contained within, at most, seven or eight files? Is that or is that not your general experience?
MR. HANNAH: Objection to form.
THE WITNESS: Well, as I said earlier, it depends on a number of factors. Context does matter because, like I say, the complexity of the function, who's writing the code -- a number of things come to play in determining, you know, how many files --
BY MR. TOMASULO:
Q I'm sorry, but my question was is it or is it not your general experience that evidence of how a particular function is performed in a product is typically contained within, at most, seven or eight files? Is it or is that not your general experience?
MR. HANNAH: Objection. Form. Asked and answered. Counsel, you're starting to harass the witness. He's giving you an answer. You're cutting him off, and this is completely irrelevant to the declaration that he submitted in this case. You're -- you've been wasting an hour now on these -- these matters that have nothing to bear with the 15-page declaration he submitted.
MR. TOMASULO: It's his CV I'm going

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through. So let me -- if you want to call the board, call the board.
Q Have you ever testified that it is, quote, your general experience that evidence of how a particular function is performed in a product is typically contained within, at most, seven or eight files of source code?
MR. HANNAH: Objection. Form. Asked and answered.
THE WITNESS: I don't remember whether I have or haven't.
BY MR. TOMASULO:
Q Okay. So in reaching your opinion of non-infringement on behalf of Google and Motorola, did you rely on source code?
A I was asked to review source code as part of my expert witness work in that case, yes.
Q And did you rely on the source code to form your opinion of non-infringement?
A The source code that I reviewed was in support of an expert report that was written by Dr. Bovik regarding the way in which the camera inside the Motorola smartphone was able to identify faces in a scene. So as such, my analysis of the source code was not used by myself to form an

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opinion on the question of infringement but was, rather, used by Dr. Bovik in his formulation of opinions.
Q Did you offer an opinion of non-infringement?
A Yes.
Q Okay. And did you rely on confidential design documents in -- to form your opinion of non-infringement?
A Yes.
Q And did you rely on witness interviews or witness testimony to form your opinion of non-infringement?
A Yes.
Q But you did not -- and did you rely on any testing to form your opinion of non-infringement?
A Yes, we did have a number of products that we were given -- that I was given as part of the work that I did.
Q And you did physical tests on those products to form your opinion --
A Yes.
Q -- of non-infringement?
A Yes.
Q What type of test did you do?

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A So one of the accused functionalities was the ability of the smartphone to relay photos between the Internet and a third-party device over Bluetooth, and so, as part of the analysis work that I performed, I was given a couple representative devices that are Motorola Mobility devices to test the ability of the phone to relay photos between the Internet and a third-party device using Bluetooth.
Q And how did you perform the test? Did you use a packet detector or some software like that?
A So on the accused product there is a application programming interface or user interface, rather, and through the user interface I was able to configure the product to perform the use case scenario that I was analyzing.
Q Did you -- did you use any testing software to do your test?
A No.
Q Any testing hardware to do your test other than the physical device itself?
A No.
Q Okay. The next case is your -- it doesn't say what your testimony is in this case. It looks like you were representing Apple, which was probably an accused infringer, and you gave a rebuttal expert

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report.
Did you offer an opinion of non-infringement in this case?
A Yes.
Q And in that case, the case for Paul Hastings where you testified on behalf of Apple, did you review source code in forming your opinion of non-infringement?
A No.
Q Did you review confidential design documents or interview witnesses?
A No.
Q You reached the opinion of non-infringement. What was the basis for your opinion of non-infringement?
A So what I was asked to do in that case was to review the 3GPP standards to determine whether or not a device that was compliant with the 3GPP standard would infringement the claims that were asserted in that case, and so my opinion was -- was limited to that question and was added as an appendix to the expert report of Dr. Wilson.
Q I see. Okay.
And then your next case here is again for Reed & Scardino, representing a different company

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this time called EON IP Holdings, LLC.
And in that case you offered an expert opinion regarding infringement, right?
A Yes.
Q And you were deposed, right?
A Yes.
Q And in that case did you rely on source code to form your opinion of non-infringement -- I'm sorry. Your -- did you rely on source code to form your opinion of infringement?
A No.
Q Did you do any testing of the device?
A No.
Q Did you rely on any confidential design documents or witness depositions?
A Yes.
Q Okay. And then again for EON IP Holdings you offered an opinion of infringement on behalf of EON, again. And in that case did you review any source code to form your opinion of infringement?
A No.
Q Did you do any testing of the device or the accused system?
A No.
Q Did you review any confidential design

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documents -- did you rely on any confidential design documents or witness deposition testimony in forming your opinion of infringement?
A Yes, I did.
Q Okay. And here for Perkins Coie you had a case for Intel.
You testified regarding non-infringement; do you see that?
A Yes.
Q And in that case did you review source code to form your opinion of non-infringement?
A Yes.
Q And did you do any testing of the system to form your opinion of non-infringement?
A Only my mental analysis of the source code I was looking at.
Q Okay. And did you rely on confidential design documents and witness interviews or testimony to form your opinion of non-infringement?
A Yes, all of the above.
Q Okay. And then the next case for Harris Corporation you offered an opinion on infringement as well, right?
A Yes.
Q Did you offer an opinion that the accused

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products infringe the patents?
A Yes.
Q And did you rely on source code in forming that opinion?
A No.
Q Did you rely on any testing of the device to form your opinion of infringement?
A Yes.
Q What type of testing did you do?
A Well, because this case involves the use of RF technology and smart antennas to communicate packets of information, I had to set up a lab experiment using a protocol sniffer that would capture packets that were transmitted over the air between two of the accused products in order to determine whether or not those products were performing the steps outlined in the claim elements.
Q Okay. And what is a protocol sniffer?
A A protocol sniffer is a type of testing tool that will capture in what's called promiscuous mode all of the packets that are being communicated across the medium that's under test, whether that's a wired medium, such as an Ethernet cable, or if that's a wireless medium.
Q And so that will help you determine

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network traffic?
A It allows me to monitor the network traffic that is being communicated across the medium.
Q Okay. And how long did it take you to do those tests?
A Let's see. Those tests were performed over the course of about two to three weeks.
Q Okay. And do you know what software you used?
A I know I at least used Wireshark but may have used another tool as well.
Q And what is Wireshark?
A Wireshark is a type of network protocol analyzer tool that is used for the purpose of monitoring networking traffic that is communicated over a medium, whether it's wired or wireless.
Q Okay. And had you ever used Wireshark before?
A Yes.
Q In -- in what context?
A So throughout my career as a networking engineer building networking products for a number of companies, I've had to rely on a number of tools, including Wireshark, to test the implementation of

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the protocol features in the product that was being developed, including going as far back as my days working at Wireless Access, which was back in the '95 time frame. I was using Wireshark to monitor the network traffic communicated over the wireless medium for the two-way paging network to determine whether or not our products as well as the products of -- of our competitor were compliant with the proprietary ReFLEX protocol.
Q What type of things can you detect with Wireshark? Let me say it differently.
What type of things have you used Wireshark to detect?
A So Wireshark is a very versatile tool as a protocol analyzer. It can analyze literally hundreds of different types of protocols, and --
Q What do you mean by a "protocol"?
A So a protocol is a collection of functions, procedures, and message formats that are defined by engineers as a language, if you will, that is used for two computers to communicate with each other.
Q So Wireshark can detect protocols.
What else can it detect?
A Well, it's primarily designed for the

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monitoring and analysis of protocol functions over the medium, whether it's wired or wireless. That's its primary usage.
Q And can it -- can it help map network traffic?
A What do you mean by "map network traffic"?
Q To show what -- who was communicating with whom.
A Well, you can configure Wireshark to display all of the contents of each and every packet that it has captured, and as part of a typical packet -- for example, if it were to capture an IP packet, then it would display all of the fields associated with that IP packet including the source address, which would be the IP address where the packet originated, and the destination address, which is the -- the end destination where the packet is headed, but then there are a number of additional fields also that you can display and monitor as part of Wireshark.
Q Okay. Is it considered a reliable tool for the functions you've just described?
A It's widely used for that purpose, for testing functionality, not just the IP protocol or -- or even other standard protocols, but it also can

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be configured to examine proprietary protocols as well.
Q And how many times have you used Wireshark?
A I don't know that I can give you an accurate number of times. I know that I've used Wireshark quite a bit over the years.
Q Okay. And how many times have you used it in the context of litigation, either to form an opinion of infringement or non-infringement?
A I know I used it in that case -- the Ruckus Wireless case. I don't recall using it in other cases.
Q Okay. Are there other types of -- you called it a protocol sniffer. That's -- is that the general category of software which Wireshark falls into?
A It's a type of protocol sniffer, but it's -- it's really a complete testing tool that allows you to capture and store packet communication over a period of time and even allows you to create packets that are injected into the communication stream. So a packet sniffer is really a very limited functionality device which will simply listen to communication in what we call promiscuous

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mode of the driver.
Q What does that mean, "promiscuous mode"?
A So typically in the low-level drivers that are used for communication over either a wired or a wireless medium, the low-level software, which we call a driver, which is interfacing directly with that communication hardware, is programmed or configured to listen to packets that are -- that have a specific destination address or a specific set of destination addresses and to reject any packets that do not have that particular destination address.
But the drivers have a mode called promiscuous mode within which the driver does not filter the packets according to whether or not their destination address is on the list of configured destination addresses, but, rather, will pass to the upper layers of the software all packets received regardless of their destination address.
Q Okay. And so how many products -- you said you used Wireshark for two to three weeks to support your opinion of infringement in the case against Ruckus Wireless, right?
A Yes.
Q And do you -- how many products were you

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testing?
A I believe there were three to four products.
Q Okay. And did the opposing side offer a rebuttal test?
A Not that I'm aware of.
Q And was your test ultimately -- was it challenged in any way by the court? Did someone say your test is no good; it's not admissible?
A No.
Q The next case for -- it looks like you were representing some defendants in a case brought by InterDigital. You offered some opinions on infringement and non-infringement; is that right?
A So I offered expert reports in which I -- in those reports I had opinions that the accused products were not infringing the asserted patents as well as expert report on the patents themselves being invalid, and, in addition to that, I published witness statements in which I testified in written form -- in a Q-and-A fashion in written form on these issues of infringement and validity.
Q So did -- in forming your opinions of non-infringement or infringement, did you rely on source code in this case?

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A No. No.
Q Witness testimony or witness interviews?
A Yes.
Q Confidential design documents?
A As I recall, I looked at a number of technical documents. I'm not sure whether I would characterize them as design documents. My main focus was on the 3GPP standard and the requirements of that standard as it relates to the asserted claims.
Q So the question, briefly, was really more whether the standard, which could be reduced to a public or semi-public writing -- whether that standard caused infringement or not.
A Whether or not the accused products, number one, were implementing the standard and in particular the required elements of the standard that related to the question of infringement.
Q Okay. In the next case here -- and did you do any testing in that case? Sorry. And that case referring to the Nokia, Huawei, and ZTE case.
A No.
Q And the next case here, it says you offered an opinion regarding infringement for EON IP again.

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Do you see that?
A Yes.
Q Did you rely on any source code in forming your opinions of infringement there?
A I believe so, yes.
Q Okay. And did you rely on confidential design documents and witness depositions from the engineers?
A Yes.
Q Okay. And then the next case was -- and did you do any testing in that case for EON against Sensus, et al.?
A In that case I did not perform physical testing.
Q Okay. Next one, Sidley & Austin was your client. You were representing Research in Motion again. And you are testifying -- it doesn't say. I'm assuming you were offering an opinion of invalidity or non-infringement or both. Do you recall?
A So in this case this was a -- this was a very -- it was a short involvement. I wrote a declaration on the issue of non-infringement.
Q Okay. And did you rely on any source code or confidential design documents in reaching that opinion of non-infringement in that case?
A No.
Q Okay. Did you rely on any witness interviews in reaching the short opinion on non-infringement in that case?
A No.
Q And what did you rely on in reaching your opinion of non-infringement in that case?
A I looked at the --the wireless standard and the requirements of the wireless standard for any compliant device such as the accused products.
Q And is that -- is that a confidential document, the -- the wireless standard documents?
A No.
Q And it's not a short document either, right? It's a very detailed document?
A Well --
Q I thought you said they could be thousands of pages?
A Yeah. I'm just trying to, you know, be clear that the -- the wireless standards are -- are living documents. So we're constantly meeting every couple of months to revise them and publish what are called amendments to the document.
So there is what's called a base standard,

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and then there are a series of amendments to the base standard, and then every few years the amendments are rolled up into a new base standard. So the standard is really -- at any time that standard is a base standard plus any amendments that have been made to the base standard at that time so that it may comprise more than one document and often cases -- for example, in the 3GPP world, the LTE standard is a collection of hundreds of documents.
Q Okay. And then the next time you -- it looks like you offered a Texas -- for White Case you offered a rebuttal expert report involving wireless LAN protocols.
Was that an infringement or non-infringement report?
A That was on the question of non-infringement.
Q And what -- did you rely on source code or confidential design documents to reach your opinion of non-infringement there?
A Yes.
Q Okay. And did you rely on witness interviews or witness depositions?
A Yes.

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Q And did you do any testing?
A No. I simply reviewed the source code and the VHDL code.
Q Okay. And then your next case here is for Perkins Coie.
Is that -- who was your point of contact there? Was that Mr. Andre again, who I believe used to be at Perkins Coie?
A No, that was not Mr. Andre.
Q Different team?
A Yes.
Q Okay. And it looks like -- did you not offer an opinion on infringement? It looks like it's just claim construction.
A Correct.
Q Okay. And then the next one here you offered a expert report for EON again. And that was a -- did you offer an opinion on infringement there?
A Yes.
Q And did you rely on source code to form that opinion?
A No.
Q Did you rely on confidential design documents or a standard --
A Yes.

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Q -- setting document?
Which one?
A That was the ReFLEX standard, which is a proprietary two-way paging protocol published by Motorola.
Q Okay. So you had a detailed standard to rely on to form your opinion; is that right?
A Well, the combination of that and the fact that I worked closely with Motorola as they were developing the ReFLEX standard back at Wireless Access and -- and built the testing platform that tested two-way paging devices that implemented the ReFLEX protocol to make sure they were compliant with all elements of the protocol before they were certified to operate on the SkyTel network, for example. So I had a lot of personal experience with the ReFLEX protocol in addition to the document in front of me.
Q Did you do any testing in that case?
A No.
Q Okay. Why not? It sounded like you knew how to do a test in that case.
A Well, you know, like I say, you know, I worked closely with Motorola as they were developing the protocol and implemented the testing platform

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that was used to test these ReFLEX products. So I knew the products pretty well and how they worked and how the protocol worked.
Q It had already been tested?
A So I already knew how it -- how everything worked.
Q As a result of the testing you had already done at Motorola?
A And in general my experience working with the network and the products, et cetera.
Q Okay. McDermott, Will & Emery representing GE Licensing in this case here. It does not say -- is it involving modem technology? Is there -- did you offer an opinion on infringement or non-infringement in this case?
A Yes, I offered an opinion on -- on non-infringement of -- or infringement, rather, of the accused products by Agere.
Q So you -- your client was the patent owner; is that right -- or patent holder?
A Yes. I was retained by McDermott, Will & Emery, who was representing the plaintiff in that case.
Q And you testified that the accused products were infringed?

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A Yeah, were infringing the patents, yes.
Q Right. And then two were found infringed and two weren't. Were your -- was there a -- did you testify regarding all four?
A Yes.
Q Okay. And did you rely on source code or confidential design documents to form your opinions of infringement in that case?
A Yes.
Q And did you rely on any testing to form your opinion of infringement in that case?
A No.
Q And did you have -- did you review any deposition testimony to form your opinion of infringement in that case?
A Yes.
Q Okay. In your next case here you're representing Cisco, again, regarding communication protocols, and you gave an opinion -- it looks like the patents were found valid and infringed; is that right?
A Yes.
Q And you gave an opinion -- I assume that you gave an opinion that they were not infringed; is that right?

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A Yes.
Q And in forming your opinion of non-infringement, did you rely on source code or confidential design documents?
A Confidential design documents.
Q And did you have -- did you -- in forming your opinion of non-infringement, did you interview Cisco witnesses or other engineers?
A No.
Q Just the confidential design documents was the basis of your opinion of non-infringement?
A And also reviewing deposition transcripts --
Q I see.
A -- and the expert reports from --
Q Okay.
A -- for Commil.
Q Almost done here.
You have a case for co-defendants. It looked like you gave a -- did you give an opinion or any opinions in these cases brought by Commonwealth Scientific regarding non-infringement or infringement?
A Yes, I offered an opinion of non-infringement on behalf of the joint defense

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group.
Q Okay. And did you rely on any confidential design documents or source code to develop that opinion?
A Yes.
Q And did you rely on any witness interviews or deposition transcripts to form that opinion?
A Yes.
Q And did you perform any testing of the accused devices or systems to form that opinion?
A No.
Q Okay. And ultimately the patents were actually found valid and infringed; is that right?
A Yes, we did stipulate to infringement; that's correct.
Q Okay. But you had testified that the patents weren't infringed?
A Correct, under the prevailing claim construction order at that time, which was changed on the eve of trial.
Q I see. Now, in this Keker & Van Nest case you just offered testimony on claim construction opinions and did not form an opinion of infringement or non-infringement; is that right?
A Yes.

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Q And here for -- you were work with Niro Scavone, and you testified -- you authored an expert report regarding infringement.
Do you see that?
A Yes.
Q And that technology is, again, cell phone technology; is that right?
A Yes.
Q And did you rely on any source code or confidential design documents in forming that opinion?
A Confidential design documents.
Q Okay. And did you rely on any deposition transcripts in forming that opinion?
A Yes.
Q Okay. And any testing in that case?
A No.
Q So as -- as far as you can recall, the testing using a protocol sniffer is restricted to the Harris v. Ruckus Wireless case; is that right?
A As I recall, that's the -- the one case where I did use the Wireshark.
Q Okay. So you were -- you were retained in this case in 12/15; is that right? It says on your CV.

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A December 2015, yes.
Q Okay. And --
MR. HANNAH: If we're moving on to a new topic, can we take a break?
MR. TOMASULO: Yeah. Absolutely.
THE VIDEOGRAPHER: Going off record at 10:57 a.m.
(Recess.)
THE VIDEOGRAPHER: Back on record at a.m.
BY MR. TOMASULO:
Q So to sum up to say, in the course of your testimonies as an expert, you have provided testimonies on infringement and non-infringement multiple times, right?
A Yes.
Q And in each of -- in many of those cases you relied on source code, correct --
MR. HANNAH: Objection.
BY MR. TOMASULO:
Q -- in forming those -- in many of those cases you relied on source code or confidential design documents to form your opinion, correct?
MR. HANNAH: Objection to form.
THE WITNESS: I think in most all of them

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I relied on confidential technical documents, and in some of them I looked at source code as well.
BY MR. TOMASULO:
Q And in most of them you relied either on deposition transcripts from engineers or interviews with engineers, right?
MR. HANNAH: Objection. Form.
THE WITNESS: In some cases there were -- there was testimony from employees of the company accused of infringement. For the most part there were depositions of experts who were in the case and employees who may have been managers overseeing various groups.
BY MR. TOMASULO:
Q And in certain instances you relied on extensive technical documentation from a standard-setting agency, right?
A Yes, in many cases I had to review standards documents.
Q Is there any case that you can recall where you reached an opinion of infringement or non-infringement without reviewing either source code or some other confidential technical design document or witness testimony?
MR. HANNAH: Objection to form.

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THE WITNESS: There was the one declaration that I mentioned earlier, which was added as an appendix to another expert's report, in which I reviewed the 3GPP standards to determine whether or not the requirements of the standard proved or disproved infringement.
BY MR. TOMASULO:
Q And in that case you had an actual standard-setting document to rely on, right?
A Yeah, set of documents. Yes.
Q So other than that case, is there any other case you can recall where you reached an opinion of infringement or non-infringement without reviewing either source code or some other confidential technical design document or performing testing?
MR. HANNAH: Objection to form.
THE WITNESS: I don't recall any.
BY MR. TOMASULO:
Q Okay. When -- you were retained in 12/15.
What was the scope of your assignment when you were retained?
A In this case?
Q Yes. I'm sorry. Yeah, in the present case.

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A Okay. So the scope of my assignment was to look at the secondary considerations of nonobviousness with respect to the -- the asserted patents.
Q When did you first read any of the asserted Boeing patents?
A I think shortly after the engagement started.
Q Okay. And the patent that we're here to talk about today is U.S. Patent 6,732,147, right?
A Sounds right.
Q Okay. And if I call that the '147 patent, is that okay?
A Yeah.
Q When was the first time you read the '147 patent?
A The first time I read it?
Q Yeah.
A When I was engaged to work on this case.
Q How many hours have you spent, all told, on your assignments for Acceleration Bay in these matters?
A About 75 hours.
Q And is that including your witness preparation time for today or is that in addition --

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or is that separate?
A Including witness prep time.
Q And what is your hourly rate?
A Six hundred.
Q And you were retained directly by Kramer Levin, or were you retained through a search firm?
A No. I was retained directly by Kramer Levin.
Q So all 600 of the dollars is --
A Yeah.
Q -- yours?
What did you do to prepare for this deposition?
A I went back over the -- the declaration -- the two declarations that I submitted with respect to the '147 patent, the dec- -- the original declaration and then the supplemental, and then I also went through the exhibits for those declarations, which included looking at the '147 patent itself, looking at the claim chart that I created, looking at Mr. Bourassa's invention disclosure form, and a number of other documents.
Q How many -- and did you have -- did you have meetings to prepare for this deposition? Meetings with counsel? meetings with anyone?

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A I did have a meeting with counsel yesterday.
Q Okay. How long was that meeting?
A The meeting itself lasted maybe an hour, hour and a half.
Q Okay. And that's the only meeting you've had to prepare for this deposition -- or phone call?
A Yes, that's the meeting that I had to prepare for this deposition, yes.
Q And in that context, who was present at that -- either in person or telephonically at your preparation meeting?
A Mr. Hannah.
Q Have you ever met Mr. Eric Cole?
A Yes.
Q When was the last time you spoke with him?
A It had to be at least a few months ago.
Q Okay. Now, you -- your testimony indicates you relied on the declarations of Drs. Bourassa and Goodrich; is that right?
A Yes.
Q And you relied on those to form your opinions?
A In part, yes.
Q Okay. And did you talk to Professor

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Goodrich?
A No.
Q And did you read and understand his whole declaration?
A Yes.
Q Okay. And were there any parts of his declaration you disagreed with?
A Not that I recall.
Q Okay. And for Dr. Bourassa -- I believe it's a doctor -- did you talk to him ever?
A No.
Q Have you ever spoken with either Dr. Goodrich or Bourassa?
A No.
Q Okay. How -- did you read the entire declaration from Dr. Bourassa?
A Yes.
Q And then it attached an invention disclosure statement.
Do you recall that?
A Yes.
Q Did you read that entire invention disclosure statement?
A Yes.
Q And did you rely on both of those -- the

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declaration and the invention disclosure statement -- to form your opinions?
A Yes, in part.
Q Okay. And did you -- did you understand both of those documents?
A Yes.
Q And did you disagree with any part of the Bourassa declaration?
A No.
Q And did you disagree with any part of his invention disclosure statement?
A No.
Q Now, between the Goodrich declaration and the Bourassa declaration, that's a fair amount of material.
How much time did you spend studying that material?
A I don't know that I can parse it out. I basically had a volume of material to go through, and so typically what I'll do is I'll review, say, a declaration, and in the course of reviewing that declaration, to refresh my memory, I'll turn to the patent. So I'll bounce back and forth between documents while I'm reviewing the collection.
So it's hard to say, you know, how many

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minutes was spent focusing on just one document because I'll look at a number, go back and forth between them.
Q When did you first see either declaration?
A After they were submitted in this case, I saw them. I don't remember the exact date.
Q So you don't think you saw the declarations until they were submitted?
A I didn't see any drafts or anything like that.
Q Okay. Did you perform any tests in reaching your opinions?
A No.
Q Are you a video game guy? You know, do you play video games, that kind of stuff?
MR. HANNAH: Objection. Form.
THE WITNESS: I have played them in the past, yes.
BY MR. TOMASULO:
Q Okay. When was the last time -- have you played any games on the Microsoft Xbox One counsel -- console? I'm sorry.
Have you played any games on the Microsoft One Xbox console?
A I don't think so, no.

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Q Okay. So you reviewed the asserted patents, correct?
A Mm-hmm.
Q You reviewed the prosecution history?
A Yes.
Q Okay. You didn't do any testing, right?
A No physical testing.
Q Okay. And you didn't review any source code, right?
A Correct.
Q And did you -- can you talk with -- or is there -- is there any other materials beyond what's identified in your report that you relied on in forming your opinions?
A With respect to the '147 patent, all the material I relied on is disclosed in the declarations.
Q Okay. During the course of this engagement, you have never spoken with Dr. Goodrich; is that right?
A Correct.
Q And you have not spoken with Dr. Bourassa either, right?
A Correct.
Q And how about Dr. Holt?

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A Same thing.
Q Okay. And in the course of this engagement, have you spoken with Dr. Cole --
A No.
Q -- Eric Cole?
I don't know if he is a doctor or not.
A No.
Q Okay. How about -- do you know someone named Dr. Medvidovic?
A I've heard the name.
Q Have you ever spoken with him?
A No.
Q And then what attorneys have you worked with in the context of this -- this IPR matters?
A Mr. James Hannah and Ms. Nguyen.
Q And that's it?
A Yes.
Q Okay. So you've never worked for a video game company, right?
A Correct.
Q Okay. And you've never been retained by a video game company as an expert witness, right? Well, you've been retained by Microsoft in a case; is that right?
A Yes, yes.

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Q But in the context of that case you never even physically inspected an Xbox One, right?
A Correct.
Q And that's really your lone experience with the video game industry, right?
MR. HANNAH: Objection to form.
THE WITNESS: What do you mean by "experience"?
BY MR. TOMASULO:
Q Well, you haven't testified for a video game company other than this one experience involving the 802.11 standard on the -- as it was being implemented by the Xbox console, right?
A Right. Outside of that case, I've never testified for a video gaming company.
Q Okay. Do you know much about the video game market?
A I -- I know what I've learned from reviewing documents given to me in this case, some aspects of the video gaming market.
Q Do you have any idea what successful video game -- like, what would be an average annual sales of a successful video game in, say, 2000 or 2006 or today?
MR. HANNAH: Objection to form.

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THE WITNESS: So in my review for this case there were some financial documents disclosed which talked about video gaming sales. I don't remember the exact numbers off the top of my head, but those numbers were included in the documents that I have reviewed in this case.
BY MR. TOMASULO:
Q What -- do you know how Activision or EA or Take-Two generates revenue from online multiplayer games?
A I have not investigated that.
Q What is a gaming console?
A Well, generally speaking, a gaming console is a product that's produced by a gaming manufacturer for the purpose of running an application or a set of applications that would be considered computer games.
Q And what are the -- what are the different consoles that you're aware of?
A Well, there are a wide number of them that have been accused of infringement, and I don't know that I can rattle off all the names, but certainly manufacturers such as Sony and EA Sports and Rocket Star [sic], and Activision, et al. produce gaming applications.

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Q Okay. And do they all produce game consoles?
A They all produce gaming applications, which is what I really focused on and not hardware, necessarily.
Q So you didn't focus on hardware?
A For the purpose of my assignment, which was the secondary considerations of nonobviousness, I focused on the documentation in this case that was describing the functionality of the gaming applications.
Q Okay. So hardware was not something you studied?
MR. HANNAH: Objection to form.
THE WITNESS: I think what I've studied I've disclosed, and, like I said earlier, I looked at the functionality of the -- the gaming applications that -- that are accused.
BY MR. TOMASULO:
Q Do -- do you know how long the typical development cycle is for a major video game?
A I -- I don't know the -- the typical development cycle time for a gaming application.
Q Do -- do you know how the games are developed?

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A They're developed by software developers who write code that implements the application.
Q Okay. And do you know how they're sold?
A They're sold to end consumers through a variety of marketing channels.
Q Any idea how many lines of code is in a -- in any of the accused video games or in any major video game?
MR. HANNAH: Objection to form.
THE WITNESS: I have not counted the lines of code in any particular gaming application.
BY MR. TOMASULO:
Q But, I mean, can you hazard a guess as to how many -- I mean, you've identified a series of games that are in your charts.
Do you have any idea how many lines of code those games have? Thousands? Hundreds of thousands?
MR. HANNAH: Objection to form.
BY MR. TOMASULO:
Q Millions? Billions?
A Well, you know, certainly these games, when they're online games, have software running in a variety of -- of devices, and some of that code is unique on different devices, and some of it's

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duplicated across devices. You know, I have not considered all of the network nodes that are required to implement a gaming application to consider, you know, how much code in toto resides in all of those networking nodes to implement an online gaming application.
Q Okay. What are the most important features that are valued by consumers in video games? Let's start with in the year 2000.
MR. HANNAH: Objection. Form.
THE WITNESS: What are the ...?
BY MR. TOMASULO:
Q Most important features that are valued by consumers, end users for -- for video games?
A I haven't performed that marketing analysis.
Q And so you don't know that for today or for 2006, for any time period, really, right?
MR. HANNAH: Objection. Form.
THE WITNESS: I did not perform a market analysis in the work that I have performed in this case; so I don't know.
BY MR. TOMASULO:
Q Do you know what Durango is?
A Yes.

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Q What is that?
A Well, the -- the word "Durango" is a marketing term that's used in a variety of contexts to refer to a variety of products from an online game to an automotive vehicle.
Q But do you know what it means in the context of -- of these petitioners or these cases?
A It's --
MR. HANNAH: Objection. Form.
THE WITNESS: -- a marketing term.
BY MR. TOMASULO:
Q Can you be more specific? I mean, do you know what it -- for instance, if Activision uses the term "Durango," do you know what it would be referring to?
A It's referring to a product --
Q A product?
A -- that -- that they make, yes.
Q Okay. And then how about Demonware? What's Demonware?
A Well, that would refer to an application that's running as a process on a particular node that would listen for incoming packets and then reacting to that to perform various operations.
Q What is Teredo? Have you ever heard of

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the term "Teredo"?
A Teredo.
Q T-e-r-e-d-e -- T-e-r-e-d-o, Teredo.
T-e-r-e-d-o.
A I'm not recalling that --
Q Okay.
A -- term.
Q What's a game engine in the context of a video game?
A So a game engine would be a set of software within the gaming application which is performing a number of core functions that are required by the application.
Q Okay. And so -- I'm sorry. What -- what were you -- what were -- did you finish your answer when you were asked to identify all of the different game consoles that you were aware of?
A So I'm trying to remember off the top of my head all gaming consoles. I know there were a number asserted in this case which I've documented in my declarations from the -- the parties in this case, and that's an extensive list. I don't know that I'm remembering each and every one of them as of this moment, but, as I mentioned before, there are gaming consoles and applications from each of

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the parties that they manufacture and sell.
Q Okay. So your testimony is that each of the parties manufacture gaming consoles and applications; is that right?
A And --
MR. HANNAH: Objection. Form.
THE WITNESS: -- and/or applications, yes.
BY MR. TOMASULO:
Q And/or applications. Okay.
And then -- but can you name any of those game consoles?
MR. HANNAH: Objection. Form.
And feel free to refer to your declaration, if you need to.
THE WITNESS: Yeah, I would have to just to be -- just to be accurate, just refer to it to make sure that I'm referring to specifically what I have mentioned is the basis for my opinions.
BY MR. TOMASULO:
Q Well, I'm just asking you as you sit here today. I mean, you've offered testimony about the secondary considerations of nonobviousness and the impact of a license in a market for video games, and I'm just asking to see what you know about the industry. I'm not asking you to recite what's in

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your declaration. So your answers are your answers right now.
The -- how does Sony make money from online multiplayer gaming?
A By charging consumers.
Q Okay. So who do they charge? Like, what are the different revenues streams that they get?
MR. HANNAH: Objection. Form.
THE WITNESS: I've -- I have not looked into all the revenue streams that they've used for -- as sources of income.
BY MR. TOMASULO:
Q Just name the ones that you're aware of. Any in particular that you can associate -- well, let's take a step back.
What's online multiplayer gaming?
A So that's a term which refers to a gaming application that involves multiple participants who are playing the game in an online context, which means over the Internet.
Q Okay. And so in that context how does Sony make money?
A By selling and/or renting the gaming application to end users.
Q Okay. Any other ways?

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A There could be other ways, such as advertising revenue, et cetera, which are also sources of income.
Q Did you physically operate a PlayStation 3 or 4 in the context of -- of your retention in these cases?
A No.
Q Did you see one? Did you touch one?
A I did not physically handle one in the course of this litigation.
Q Okay. So just to be clear, you did not -- in the course of your retention, you did not physically see or touch a Sony PlayStation 3 or 4, correct?
A Correct.
Q Okay. And have you -- and in the course of this retention you did not physically see or touch a Microsoft Xbox One or Xbox 360, right?
A Correct.
Q Okay. And in the course of this retention did you physically see or touch any of the accused games, for instance, Destiny?
A No.
Q Okay. And then there's a number of videos that are cited to in your report, right? Do you

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recall that?
A Yes.
Q Did you --
MR. HANNAH: Which report, Counsel? I think you might be referring to the one tomorrow.
BY MR. TOMASULO:
Q You have identified in at least some of your reports videos -- YouTube videos, things like that, right?
A I looked at a wide variety of evidence online, such as YouTube videos and other things as well, yes.
Q And did you make -- did you watch those YouTube videos?
A In the preparation of my report, yes.
Q Okay. So you did that before you reached your opinions?
A Yes.
Q Do you know what the major technology problems in the video game industry were in, let's say, 2006?
A Let's see. In the course of my efforts here in this litigation I did not examine the full range of technical problems experienced by the gaming industry in 2006.

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Q Can you identify any that you're -- that you're aware of for a certainty they were experiencing in 2006?
MR. HANNAH: Objection. Form.
THE WITNESS: I was not working for a gaming company at that time.
BY MR. TOMASULO:
Q So you can't, right?
A So --
Q If I asked you --
A I'd have to have access to that information to know specifically what a particular gaming company was experiencing at that particular time in 2006.
Q I understand. I'm not -- I just want to know.
A Mm-hmm.
Q So you -- so you don't know what the challenges were at that time, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Not for a specific company that's listed as one of the accused companies in this litigation in 2006, no.
BY MR. TOMASULO:
Q Do you know what challenges Sony was

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experiencing in context of the gaming industry in 2006?
A Other than probably competitive challenges from competitor companies.
Q Okay. Do you have any experience with patent licensing?
A I am not a patent lawyer. So I haven't licensed any patents myself.
Q And have you licensed any software?
A Again, I'm not an attorney. So I have not personally licensed any software.
Q It's not an attack on you. I'm just trying to get a feel for your experience.
So you're not a licensing professional in the context of either licensing patents or software, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Correct. I'm not a licensing professional.
BY MR. TOMASULO:
Q Okay. And no experience with licensing for video games or game consoles, right?
A Correct.
Q What's a graph? Are you able to offer a definition?

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MR. HANNAH: Objection. Form.
THE WITNESS: What do you mean by that?
BY MR. TOMASULO:
Q Well, I mean, it has a definition. Most things do. I mean, maybe there's multiple definitions. But are you able to offer a definition of what a graph is?
MR. HANNAH: Objection to form.
THE WITNESS: Well, the word "graph" is a pretty generic term. So without any context, I don't know quite how to answer the question.
BY MR. TOMASULO:
Q Okay. What's an m-regular graph?
MR. HANNAH: Objection. Form.
BY MR. TOMASULO:
Q Let's start with a different question.
What's a regular graph?
A In what context?
Q Graph theory.
A So in the context of graph theory, a regular graph would be a collection of nodes and links between the nodes where each node has the same number of links to other nodes.
Q Okay. And then what would be an m-regular or a k-regular graph?

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MR. HANNAH: Objection. Form.
THE WITNESS: So an m-regular graph within the context of graph theory would be a -- a collection of nodes and links between those nodes where each node has m links to other nodes.
BY MR. TOMASULO:
Q Okay. And then what's a complete graph?
MR. HANNAH: Objection to form.
THE WITNESS: So within the context of graph theory, a complete graph would be a graph in which a collection of nodes and links between the nodes exists such that every node can reach every other node in one link hop.
BY MR. TOMASULO:
Q Each node has a direct edge or link, as you're using the term, to every other node in the graph, right?
A Correct.
MR. TOMASULO: How about graphs? Pull the graphs. So this will be Exhibit Bims 2, I guess.
(Exhibit 2 was marked for identification by the court reporter.)
MR. HANNAH: Counsel, I'm going to object to this exhibit and any questions, and I'm going to instruct the witness not to answer any questions

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regarding this exhibit unless you can demonstrate the relevance of it and how it pertains to his declaration in this case.
MR. TOMASULO: Okay. The case is about graph theory. So, you know, I'm going to ask my questions, but I'll try to demonstrate some relevance beforehand, but I think it's pretty plain what's relevant and what's not. I mean --
MR. HANNAH: He offered an opinion on secondary considerations. This is way outside the scope of his -- of his opinions in this case. I gave you some -- I've been giving you some leniency here, but this is clearly outside the scope.
BY MR. TOMASULO:
Q Have -- have -- in -- in your testimony did you -- did you offer an opinion that the Sony PlayStation playing the game Destiny meets the limitations of the '147 patent claim six?
A No, my task was to -- was to consider secondary considerations of nonobviousness but not to reach the question of infringement of any particular claim.
Q Okay. That's -- okay.
MR. HANNAH: And, Counsel just so you have a heads-up, I will need to take a break at 11:55.

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MR. TOMASULO: Okay.
Q Okay. So do -- did you --
Let's go ahead and mark your declaration. She can put that over that. This will be Bims No. 3. You can put the sticker right on top of my writing.
(Exhibit 3 was marked for identification by the court reporter.)
MR. TOMASULO: Here's a copy of his declaration. I gave him one that has the actual CV because I had separated that out. So you have the declaration and the CV now.
MR. HANNAH: Sure.
MR. TOMASULO: Just to be clear, his has got the whole thing.
Q Okay. So this is your declaration, right?
A Yes.
Q Okay. And you -- you signed it on December 15th, 2016; is that right?
A Yes.
Q Okay. And then -- and so you -- if we go to page -- page 10, paragraph 28 --
A You said page 10, paragraph 28?
Q Yes. Is that -- do you not see that? Is that paragraph 28, "In my opinion"; is that -- do --

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A That's page 9.
Q Oh, okay. I'm just looking. I see it's page 9, but it's stamped page 10 at the bottom.
A Oh. Got it. Yeah. I see that.
Q Okay. So paragraph 28. Can you just read the whole paragraph for me into the record.
A So paragraph 28 says, quote, 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 patents. This chart is attached as Exhibit 2016. As indicated in the chart, PlayStation 3 and PlayStation 4 are covered by the '147 patent.
Q Okay. So is that your opinion?
A Yes.
Q Okay. And what you're saying here -- what are you saying when you say the chart that maps the

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claims of the '147 patent with the technology in the Sony products?
A So what I'm showing here is that it's in my opinion that it's highly likely that the Sony products are practicing the invention by creating a chart that -- that shows the evidence that I've looked at in the case going through the asserted claims one by one, showing that high likelihood that Sony is practicing the inventions.
Q It's an infringement chart that you created, right?
MR. HANNAH: Objection. Form.
THE WITNESS: No.
BY MR. TOMASULO:
Q It's not an infringement chart.
What do you mean by the term "covered" when you say "Sony markets and sells those products covered by at least one claim of the '147 patent"? What does that means, "covers"?
A So that's a general term, and, again, if I were creating a -- an infringement analysis report, I would be specific in terms of which particular claim I'm talking about and which claim element within the claim I'm talking about, but in this sentence it's very general and broad because this

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analysis was performed by looking at the '147 patent and the inventions disclosed in the '147 patent and then looking at the Sony products and making the determination that it's highly likely that the Sony products are practicing the invention.
Q Show me where you say "highly likely."
A The term "highly likely" does not appear in paragraph 28.
Q Have you ever used the word "covered" to mean infringe in any of the multiple cases where you have testified about infringement?
A No.
Q Okay. And then what about when you say "utilize the invention described in at least one claim"? What do you mean by that term? That's in paragraph 29.
A So -- you say in paragraph 29? Okay. Let me see here.
Q Just read the whole paragraph into the record.
A So paragraph 29 says: "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

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different locations around the world to communicate and interact with each other by sending data received from neighboring players to other neighboring players."
Q Okay. So is it your opinion that Sony is using -- what -- what does your opinion have to do with the validity of this patent?
A So my opinion is with respect to secondary considerations of nonobviousness.
Q Okay. So if we go to paragraph 27, is it your opinion that commercial -- a prima facie case of nexus is made when the commercially successful product is the invention disclosed and claimed in the patent?
A Yes.
Q Okay. And so what you're saying here is that -- have you applied this test? You say that the nexus is shown, right?
A Yes.
Q Okay. And so when you say the nexus is shown, is -- you're saying that the commercially successful product is the invention claimed in the patent? That's your testimony, right?
A The commercially successful product incorporates the inventions described in the '147

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patent, yes.
Q Okay. In other words, it -- in your opinion, it infringes?
A Infringement is a specific word that relates to the question of a particular asserted claim having been practiced element by element in the accused product, and I have not performed that level of detailed analysis of the accused products.
Q Okay. And what -- and what did you not do? What makes your opinion not an infringement analysis?
A So -- excuse me -- my opinion is based upon my reading of the patent itself and what it discloses in the specification about the invention and my understanding, from the documents discovered in this case, the way in which the -- the products -- the Sony products are performing and looking at that general operation to -- to reach the opinion that there is a nexus between how the Sony products are performing and the inventions disclosed in the '147 patent.
Q Okay. But you say that --
MR. HANNAH: Counsel, just to give you a heads-up: I do need to take a break.
//

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BY MR. TOMASULO:
Q You understand that you can't talk to your lawyers or anybody about this deposition during breaks, right?
A Of course.
MR. TOMASULO: Okay. I just want to make sure that we don't have an inadvertent issue with that rule. Yeah. So -- let's go off the record.
MR. HANNAH: Okay.
THE VIDEOGRAPHER: Going off record at 11:56 a.m.
(Lunch Recess.)
THE VIDEOGRAPHER: We're back on record at 12:54 p.m.
BY MR. TOMASULO:
Q Good afternoon.
A Good afternoon.
Q You have prepared infringement reports in the past, right?
A Yes.
Q And you have offered testimony where you specifically said, "I have reviewed this product, and it infringes," or "I've reviewed this product, and it doesn't infringe," right?
A Yes.

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Q And you've reached that conclusion by doing what? What steps do you perform to reach a conclusion of infringement?
A So I start by reading the patent spec itself, and then, you know, I read the -- the asserted claims in light of what's written in the patent specification, and then I also examine the file history to see if there -- if there was anything discussed with the examiner in the prosecution of the patent that could better inform what the claim terms mean or the scope of the invention means, et cetera, as I'm reviewing the asserted claims.
And then oftentimes the court will issue a claim construction order, which will provide definitions of some of the claim terms. So I'll look at that court order and substitute the court's definition for the claim terms as I'm attempting to understand what does each and every asserted claim actually mean and what does it actually cover.
And then -- then after, you know, going through all of that, then I look at the accused products, and -- and I examine the accused products from -- from either a structural sense or from a methodology sense depending on the type of claim to

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try to determine whether or not the accused product is meeting each and every limitation of a specific asserted claim.
Q Okay. And then -- and then -- then does that get you to -- all the way to an opinion that either it infringes or it doesn't? I mean, how do you make that next step? You've described a process that -- the last thing you said was comparing each claim elements to the accused product, right?
A Yes.
Q And then what? So then --
A Well --
Q -- to reach a conclusion of infringement, what would you have to determine?
A Well, to reach an opinion on infringement, I would go back and look at the analysis that I performed on each claim element, and if the analysis that I performed on each claim element shows that for each one of those claim elements the product was found to infringe that claim element for all of the claim elements in a particular claim, then I reach the opinion that the product is infringing the claim as a whole.
But if in my analysis there's even one of the claim elements in which the product does not

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meet the limitations of that particular claim element, then I say the product does not infringe the claim as a whole because there was at least one claim element in which the product did not satisfy or meet the limitations.
Q Okay. And then you prepared charts in the past before, have you not?
A Yes.
Q And those would be called infringement charts, I suppose?
A Yes.
Q Okay. And what is the purpose of an infringement chart that you have prepared?
A So in the past when I have put together infringement charts, the -- the charts really summarize the evidence that I've been looking at that form the bases of the opinion that I reach in that case.
Q Okay. And then that -- that chart itself would summarize your opinion of infringement or -- or not?
A It summarizes in one place the evidence that I'm using to support my opinion. So the infringement claim chart will have in it supporting evidence for each one of the claim elements. And

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then when I write my expert report, I'll rely on the claim chart -- the evidence that's in the claim chart to reach the opinions that are written in my report.
Q Okay. Have you ever had your testimony on infringement excluded by a judge?
A I think I had a supplemental report that was filed late, and so it was excluded because it was late.
Q Other than that?
A No.
Q So in this case you read the patent?
A Yes.
Q You read the specification?
A Yes.
Q You studied the claims that were at issue?
A Yes.
Q And you read the file wrapper?
A Yes.
Q And you compared the -- and you -- and you read Dr. Goodrich's testimony?
A Yes. His declaration, yes.
Q And in that he created some claim constructions, right?
A Yes.

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Q And you applied those?
A I did look at them, and I agree with them, yes.
Q Okay. And so you created a chart that compared the Sony product running the game Destiny to the claims of the '147 patent -- or the selected claims, right?
A In a general sense, yes.
Q Okay. And did that chart apply the claim constructions that were developed by Dr. Goodrich which you said you agree with?
A Excuse me. I was not doing a detailed analysis of -- of his constructions in that claim chart. Rather, when -- the chart that I put together in this IPR proceedings, I was simply looking at the -- the product itself and does the functionality of the product itself appear to have a high likelihood of satisfying the IPR claims components.
Q But my question is you have a section in your declaration about claim construction, right?
A Yes.
Q Okay. Did you apply that claim construction when you created your charts?
A The ones that are in my declaration, yes.

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Q Okay. So you did apply the claim construction the same way you would have applied a Markman order?
A I -- I would say not the same way.
Q In what way does it differ?
A So my claim constructions that are in my report are really documenting my understanding of what those claim terms mean when I read the claim. So armed with that understanding, I did a review of the evidence of the Sony product, and, based upon what I saw in that evidence, it appears to me that the Sony products are practicing the invention without doing the kind of detailed analysis that I would normally do with respect to an infringement opinion.
Q Okay. So at this point are you offering an opinion that the -- the material that's charted in your chart, which is -- I guess it's the Sony PlayStation, right?
A [Witness nods head.]
Q Are you offering an opinion that that infringes the claims of the '147 patent that you've charted?
A No, I'm not offering an opinion on infringement.

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Q Okay. Have you reached an opinion on infringement?
A No, I have not.
Q Okay. Have you reached an opinion on infringement -- you've offered other charts as well, right?
A You mean in other litigations?
Q No. In these proceedings in the context of the other patents where you have offered a similar declaration on secondary considerations of nonobviousness, have you reached an opinion on infringement in any of those?
A No.
MR. HANNAH: Objection. Form. Outside the scope.
BY MR. TOMASULO:
Q Okay. So it is the same story with all of those? It's not an infringement opinion?
A That's correct.
Q Okay. So you have not rendered or reached a conclusion of infringement on -- of any of these patents so far?
A That's correct.
MR. TOMASULO: Let's mark the patent. So what will this be?

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THE REPORTER: No. 4.
(Exhibit 4 was marked for identification by the court reporter.)
BY MR. TOMASULO:
Q What I have placed before you and marked as Exhibit 4 is U.S. patent --
Oh, do you need a copy?
MR. HANNAH: Yes, please.
MR. TOMASULO: You'll have to get a little binder.
Q What I've placed before you and marked as Exhibit Bims 4 is U.S. Patent 6,732,147.
Do you see that?
A Yes.
Q Okay. And this is the patent you have testified that you read, correct?
A Yes.
Q And you read the whole thing?
A Yes.
Q What is your understanding of the invention claimed in the '147 patent?
MR. HANNAH: Objection. Form.
THE WITNESS: So at a high level, what the invention is all about is the application of a broadcast channel as an overlay on top of an

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underlying point-to-point communications network for the establishment of an application layer communication channel for participants all running the same application so that they can broadcast messages to one another over an underlying point-to-point communications network.
BY MR. TOMASULO:
Q So is it a requirement of the claims that the participants be running the same application?
MR. HANNAH: Objection to form.
BY MR. TOMASULO:
Q I think that's what you just said.
A It's an application layer broadcast channel; that's correct.
Q So what you said was that it's a communications channel for participants all running the same application so they can broadcast messages to one another.
So my question is is it a requirement of the claims that the participants all be running the same application?
A They're not required to all run the same application, but the participants communicate to one another over the same broadcast channel.
Q So the participants could be running

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disparate and different applications?
A Potentially, yeah.
Q And the term "application layer" is not specifically used in the patent, right?
A Correct.
Q What do you interpret that to mean?
A So that's my way of explaining at a high level what the patent is about by making a distinction between the point-to-point communications network, which is implementing network layer routing protocols, from the broadcast channel, which is overlaid on top of those network layer routing protocols, which, if you look at the protocol stack, the broadcast channel would have to operate at a higher layer in the protocol stack than the network routing protocols.
And, as described in the '147 patent, one of the embodiments for how you would use the broadcast channel is for participants to communicate with one another to broadcast messages to one another within the context of an application, although the claims as -- as I've gone through them, the claims don't necessarily limit you to a particular application.
Q And how do you determine whether something

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is at the application layer or not? Are there rules that you use to determine whether -- if I'm understanding correctly, what you're saying is if it's not at the application layer, it doesn't meet the terms of the claims; is that right?
A No, that's not.
MR. HANNAH: Objection. Form.
THE WITNESS: That's not what I'm saying. Again, I'm just trying to give you a flavor for what the patent is all about, and the broadcast channel is an overlay on top of the networking -- the point-to-point communications network at the networking layer.
So above the networking layer you have three layers, right. You have the transport layer, the session layer, the presentation layer, and then above that the application layer. So potentially the broadcast channel could exist in any one of those or combination thereof layers, but the easiest -- easiest example to explain the broadcast channel is to use the application layer as the -- as the example.
BY MR. TOMASULO:
Q Okay. So it's not limited to just the application layer? That's your testimony?

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MR. HANNAH: Objection to form.
THE WITNESS: Correct. It just needs to be an overlay on top of the point-to-point communications network.
BY MR. TOMASULO:
Q Okay. That could be at the application layer or any of those other three layers you --
A Yes.
Q -- described?
MR. HANNAH: Objection to form.
BY MR. TOMASULO:
Q If you look at the background, do you see in the first couple of sentences it says here at the very beginning of the background -- are you there?
A Yes.
Q So it says: "There are a variety --" I'm sorry. Let me start again.
It says: "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."
Do you understand what those different protocols or middleware are?
A Yes.

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Q Okay. And so -- and those -- those are prior art systems that are not claimed by the patent, correct?
MR. HANNAH: Objection. Form.
THE WITNESS: Those are examples of communications techniques that exist in a prior art to this patent, yes.
BY MR. TOMASULO:
Q Okay. So what is meant by a point-to-point network protocol?
A So within the category of point-to-point network protocols that this sentence is describing would be protocols that exist at the -- at the networking layer, such as the IP layer networking protocols used for routing packets over the Internet, for example.
Q Okay. Any other examples you can think of?
A Well, frame relay is used for point-to-point communications. ATM is used for point-to-point network protocol communications. Ethernet is used for point-to-point communications. You know, IPX, probably a few more that I'm leaving out.
Q If you go to the next paragraph, it talks

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about UNIX, TCP/IP, and UDP.
A Yeah.
Q Are -- and are those, in your view, all prior art network point-to-point protocols?
MR. HANNAH: Objection. Form.
THE WITNESS: So a UNIX pipe is really a socket that is opened up in the UNIX operating system for communication typically within the context of a UDP or a TCP socket connection. So a UNIX pipe is really kind of a specific version of a TCP/IP network protocol stack.
TCP/IP and UDP are both referring to a merging of protocol layers at the transport and networking layers into a common implementation. TCP actually sits above IP, which is at the networking layer, and the same thing with UDP, which is sitting at the transport layer above IP at the networking layer --
BY MR. TOMASULO:
Q Okay. So -- sorry. Go ahead.
A -- to perform the networking functions.
Q Okay. So let me give you a blank piece of paper. Can you just draw those seven layers so we can have something to refer to? I don't know if you need one.

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MR. HANNAH: Objection. Form.
MR. TOMASULO: He's referring to multiple layers, and I can't keep track of them in my head when he -- so I -- why -- why can he not draw it? You are you able to draw it, the seven-layer stack you're talking about?
MR. HANNAH: I don't think it's appropriate for the witness, especially in an IPR proceeding, to be creating exhibits.
MR. TOMASULO: So you're instructing him not to do it?
MR. HANNAH: You can ask him -- actually, I don't even know -- where is this referring to -- referenced to in his declaration? That's the only thing we're supposed to be talking about today.
MR. TOMASULO: He relied on Professor Goodrich's declaration. Here. Just give that back. It sounds like you can't do it.
Q So you are unable to draw the seven-layer stack?
A I am heeding the advice of counsel to not create the exhibit.
Q But could you do it?
A I understand the layers in a networking stack, yes.

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Q So you could draw it?
A I could write down what those seven layers are in the OSI protocol stack model, yes.
Q So you said TCP/IP. What -- what layer does that sit at?
A So TCPI --/IP is a combination of the Transmission Control Protocol and the Internet Protocol, with the Internet Protocol existing at the networking layer and the Transmission Control Protocol operating at the transport layer.
Q Okay. And you said that the patent includes connections made at the application layer, correct?
A Yeah.
Q And at the presentation layer?
MR. HANNAH: Objection. Form.
THE WITNESS: Basically, at any layer that exists above the point-to-point communications protocol that's described in the '147 patent.
BY MR. TOMASULO:
Q Okay. So is -- does -- is it above -- is it restricted to things that are above the session layer, including the session layer?
MR. HANNAH: Objection.
//

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BY MR. TOMASULO:
Q I'm just trying to figure out what you believe it includes.
A Well, I think we've already outlined some examples that the '147 patent identifies in the specification of point-to-point network protocols, and given that the '147 patent says that the broadcast channel exists above the point-to-point network protocols, then at any layer that sits above any of these examples would be a candidate for a broadcast channel.
Q Okay. So any layer above the point-to-point layer?
A The point-to-point network protocol layer, yes.
Q And so for the avoidance of doubt, what layers would be at least for sure above that layer? The application layer, right?
A Well, you would look at a case-by-case basis --
MR. HANNAH: Objection. Beyond the scope.
THE WITNESS: -- at a variety -- at the networking protocols, but, you know, as a general matter, a networking protocol operates at the networking layer.

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BY MR. TOMASULO:
Q I want to know if you're able to say what layers are for sure included within your view of what could be a participant in the claim.
MR. HANNAH: Objection to form.
BY MR. TOMASULO:
Q You said -- you said it has to be above the point-to-point network protocol, right?
A Correct.
Q But there is no thing that says point-to-point network protocol in the seven-layer stack, right? That's not a layer?
A So a point-to- --
MR. HANNAH: Object to form. Outside the scope.
THE WITNESS: A point-to-point network protocol is generally operating at the network layer.
BY MR. TOMASULO:
Q So then the transport layer is a candidate -- if the connections are made there, in your view, it's a candidate to be involved in the scope of the claims?
MR. HANNAH: Objection to form. Outside the scope.

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THE WITNESS: Well, it depends on my analysis of the system in terms of what I identify in the system as the point-to-point network protocol, which I haven't done that exercise, but if I were to do that exercise, then certainly the broadcast channel would exist above it.
BY MR. TOMASULO:
Q We see here in the first sentence it talks about client server middleware.
What is your understanding of what that means?
A So client --
MR. HANNAH: Objection. Form.
THE WITNESS: -- client server middleware refers to a layer of software that resides in a end user device and also in a network node, which allows for communication between an end user client, a plurality of end user clients and a central server.
So the client server middleware description here as one of the communications techniques implies that we're referring to a network configuration in which communication from client devices directly flows to a central server.
BY MR. TOMASULO:
Q And that's outside the scope of the

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patent, correct?
MR. HANNAH: Objection. Form.
THE WITNESS: That's simply part of the background of possible communications techniques that have existed prior to the '147.
BY MR. TOMASULO:
Q Okay. So are -- is it your testimony that a client server could be within the scope of the patent?
MR. HANNAH: Objection. Form of the question.
THE WITNESS: So it's my testimony that -- that I have not analyzed the '147 patent with respect to the -- the full breadth of the coverage of the invention as to whether or not client server middleware implementations could or could not infringe the patent.
BY MR. TOMASULO:
Q What's multicasting network protocols?
A So for a multicasting network protocol, that would be a protocol that allows for communication between network nodes in which a packet that is sent from one node can be received by a plurality of destination nodes.
Q Is there any other definitions for

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multicasting network protocol that you can think of or you think that's a pretty accurate definition?
A Well, that's -- that's generally -- generally what multicasting is about, which is the ability to -- for a single packet to be transmitted to a plurality of destination nodes.
Q Okay. And is that what would have been the definition of multicasting around the time that this patent was filed, say, in 2000, 1999, 1998?
MR. HANNAH: Objection. Form.
THE WITNESS: I have not thought about that question with respect to that particular time frame.
BY MR. TOMASULO:
Q As you sit here today, can you think of any reason why the definition you just gave wouldn't be applied or applicable in 1998 to 2000?
MR. HANNAH: Objection to form.
THE WITNESS: I haven't looked into it. So I can't offer an opinion one way or the other.
BY MR. TOMASULO:
Q So you -- there is no reason as you sit here today that you could say that you think will probably be inapplicable to that time frame?
MR. HANNAH: Objection. Form. Asked and

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answered.
THE WITNESS: I haven't looked into it. So I really can't answer.
BY MR. TOMASULO:
Q Well, what's the difference between broadcasting and multicasting?
MR. HANNAH: Objection to form. Outside the scope.
MR. TOMASULO: How -- how could it possibly be outside the scope to ask questions about terms in the claims, terms in the patent when he's testified about the scope of the patents and what's within the scope of the patents? You can have a standing objection on form and outside the scope.
MR. HANNAH: I'll tell you exactly what's outside the scope. He is -- he is a witness offering a 15-page declaration on secondary considerations. He is not the main invalidity or validity expert in these IPR proceedings. You have his deposition coming next week or the week after, and that is fair -- that's fair questions about the scope of the claims, the scope of the patent, what these different terms mean.
This witness did not offer an opinion on any of these terms. He didn't put an opinion about

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multicasting or any of these other terms that you're talking about in his declaration.
And in these IPRs you're supposed to limit your questions to what's in the declaration. And I -- we've given you a lot of leeway here. So this is absolutely outside the scope of his very limited declaration in these proceedings.
MR. TOMASULO: He offered an infringement chart. He offered definitions of broadcast channel. This is crazy. He's talking about the patent. Let's call the board. I mean, I've never even heard of something like this. I'm asking him questions about the patent. This is just silly.
MR. HANNAH: You're asking about what -- the scope of the claims and what they -- and what they mean and how they apply to prior art or not. I mean, that's not what his opinion is. His opinion is on secondary consideration.
MR. TOMASULO: His opinion -- he's offered a chart that says that he has applied the claims and that the Sony PlayStation product meets the recited claim language. I'm entitled to ask anything I want about the recited claim language and how he came to that opinion. He created a chart. I'm entitled to ask him about every single word in that chart. Do

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you disagree?
MR. HANNAH: Ask about the chart, then.
You're not asking about the chart.
MR. TOMASULO: I'm asking about the patent.
MR. HANNAH: You're asking about UDP, TCP/IP. It has nothing to do with that chart.
MR. TOMASULO: It's in the patent. I can ask about anything I want in the patent. Come on.
Q So what's the difference between broadcasting and multicasting?
MR. HANNAH: Objection. Form. Outside the scope.
THE WITNESS: So as a general matter, broadcasting involves the transmission of a packet from a sending node to all of the destination nodes in the network, whereas multicasting, generally speaking, involves the transmission of a packet from a sending node to a plurality of destination nodes in the network where that plurality might be a subset of all the nodes in the network.
MR. TOMASULO: Okay. We'll mark Professor Goodrich's declaration as the next exhibit.
What is that going to be?
THE REPORTER: No. 5.

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(Exhibit 5 was marked for identification by the court reporter.)
BY MR. TOMASULO:
Q You testified that you read and relied on Professor Goodrich's declaration, correct?
A I did review it in the course of my analysis of the evidence, yes.
Q Okay. And you signed your declaration on December 15th, right?
A Yes.
Q Okay. And then if you look -- when did he sign his declaration?
A December 12th, 2016.
Q Okay. So did you review it sometime between December 12th and December 15th?
A Yes.
Q Is that the first time you saw it?
A Yes.
Q If you could turn to page 18. Do you see paragraph 40?
A Yes.
Q Can you tell me if there's anything -- if you view this as a correct statement, the -- the second sentence there that begins, "More particularly"?

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A It says in paragraph 40: "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."
Q Is that a correct description of the '147 patent, in your opinion?
A I agree with that high-level description of, in general, what the '147 patent is about.
Q Okay. And then if we go to paragraph 41, do you see the statement here: "Such a network arrangement where each node in the network is connected to the same number of other nodes as -- known as an m-regular network"?
A Yes.
Q Is that, in your view, an accurate statement?
A Yes, I agree with that statement.
Q And do you agree with the statement that "A network is m-regular when each node is connected to m other nodes in a steady state and a computer will become disconnected from the broadcast channel only if all m of the connections to its neighboring

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nodes fail"? Do you agree with that statement?
A Yes.
Q If you go to the next page at the top, do you see the first full sentence there states: "The '147 patent also describes a computer network in which the number of network participants, N, (In figure 2 this is 20) is greater than the number of connections m to each participant (In this figure 2 this is 4)"?
Is that an accurate statement?
A I agree with that statement.
Q And the next sentence: "This network topology, where no node is connected to every other node, is known as an incomplete graph."
And that's a correct statement, right?
A Yes.
Q In the next sentence here it says: "The incomplete graph topology relies upon participants to disseminate information to other participants."
Is that a correct statement?
A Within the context of the '147 patent, that's a correct statement, yes.
Q Okay. And then the next sentence: "As described in the '147 patent, to broadcast a message, the originating computer sends a message to

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each of its neighbors using the overlay network."
Is that a correct statement?
A Yes, that's a correct statement of what's in the specification.
Q Okay. And then it says: "Each computer that receives the message then sends the message to its neighbors using the network."
Is that a correct statement?
A Yes, that's a correct summary of what is described in the patent specification.
Q Okay. And then it says: "In this way the message is propagated to the each computer of the overlay network using the underlying network, thus broadcasting the message to each computer over a logical broadcast channel."
Is that a correct statement?
A Yes.
Q And then if we go to the next paragraph, 43, it says: "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."
Is that a correct statement?
A Yes, those are processes described in the

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patent specification.
Q And then it says here: "The challenged claims at issue relate to unplanned disconnections."
You agree with that, right?
A Yes.
Q And then it says: "The -- 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 each successfully [sic] attempts to send a message to the disconnected computer."
And that's a correct statement, right?
A "When each unsuccessfully attempts to send a message to the disconnected computer," yes.
Q Yes. And then it says: "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."
And is that a correct dis- -- is that a correct statement as it pertains to the challenged claims of the '147 patent?
A That is a correct statements as it relates to what the patent specification is describing.

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Q Okay. So do you think that's different than what's claimed?
A I have not looked at this portion of the patent specification as it relates to the challenged claims in this IPR.
Q Isn't this the part of the specification that relates to the claims that are at issue in this IPR?
A In the challenged claims it talks about the process of disconnecting from a broadcast channel, but I haven't looked into whether or not the challenged claims are limited to this particular portion of the patent specification.
Q Did you read column eight of the patent specification?
A Yes.
Q Did you read column nine of the patent specification?
A Yes.
Q So do you agree that the challenged claim is limited to a situation where the network is m-regular and incomplete both before and after the performance of the method?
A So which challenged claim are you referring to?

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Q Yeah. That's fine. Let's go to, I believe -- let's start with claim six, I believe is the -- is the independent claim at issue.
A So what was your question again?
Q Is it, in your opinion, a requirement of claim six that the network be m-regular where m is at least 3 and that it be incomplete both before and after the performance of the claim?
MR. HANNAH: Objection. Form.
THE WITNESS: Well, as I read claim six, the word "incomplete" doesn't appear. So what claim six says is that the broadcast channel is an m-regular graph where m is at least 3, but it doesn't say whether or not the broadcast channel must be an incomplete graph or not.
BY MR. TOMASULO:
Q Okay. So can you look at figure 3A.
A Yes.
Q Okay. So 3A is a 4-regular complete graph; is that correct?
A Yes.
Q Okay. And if we remove node E --
A Okay.
Q -- then it would be a 3-regular complete graph, correct?

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MR. HANNAH: Objection to form.
THE WITNESS: If you remove node E from figure 3A, then it would be a 3-regular complete graph.
BY MR. TOMASULO:
Q Okay. And no new connections would be needed to be formed or broken for that to happen, right?
MR. HANNAH: Objection. Form.
THE WITNESS: I'm not sure.
BY MR. TOMASULO:
Q Okay. Well, so as a -- as a -- as it is now, it's a complete graph because each node has a connection to all the other neighbors, right?
A Correct.
Q In 3A?
And then if you remove node E, then A is connected to B, C, and D, correct? It already has those connections?
A Okay.
Q And the same for B? It's connected to A, C, and D, right?
A Hm-hmm.
Q And the same -- and for C it's connected to B, A, and D, right?

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A Okay.
Q And D is connected to A, B, and C, right?
A Okay.
Q Okay. So does that meet the requirements of the graph for it to be m-regular with m is greater than 3?
MR. HANNAH: Objection.
BY MR. TOMASULO:
Q Equal to or greater than 3. I'm sorry.
MR. HANNAH: Objection. Form.
THE WITNESS: In the steady state you have an m-regular complete graph where m is 3.
BY MR. TOMASULO:
Q So in your view, would that be -- would that meet the limitation of the claim, if you go back to the claim language?
MR. HANNAH: Objection. Form.
THE WITNESS: I think what you're asking for me to do is a -- an analysis of claim six on the fly with respect to a particular figure. That's typically not how I analyze a claim for the purposes of infringement. Usually in analyzing a claim I look at the full body of the patent specification, not just the particular figure, and in light of other inputs, such as claim construction orders, in

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order to understand the full scope of the claim or even the claim term.
BY MR. TOMASULO:
Q So you're not able to -- to understand the claims right now?
A I've read and understood the claims.
Q But right now you're not able to understand them?
MR. HANNAH: Objection. Form.
THE WITNESS: I am able to understand them.
BY MR. TOMASULO:
Q Okay. Are you -- do you under- -- and you read Professor Goodrich's declaration, right?
A Yes.
Q So let's go to page 21. And do you see he has figure 5B there?
A Yes.
Q Can you explain in your own words what figure 5B is trying to show?
MR. HANNAH: Objection to form. Outside the scope.
THE WITNESS: Well, I think the patent specification makes clear what figure 5B is illustrating, which is the unplanned disconnection

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of computer H from the broadcast channel.
BY MR. TOMASULO:
Q Okay. And then walk me through the steps that happen.
MR. HANNAH: Objection to form. Outside the scope.
BY MR. TOMASULO:
Q Are you able to ask -- are you able to apply claim six to 5B?
A When you say apply claim six to 5B, what are you --
Q Is --
A -- trying to describe?
Q Is claim -- does the operation described in 5B that you just identified, a unplanned disconnection in the E link -- does that meet the limitations of claim six in your view?
MR. HANNAH: Objection to form. Outside the scope.
MR. TOMASULO: How could it possibly be outside the scope? It's talked about right here in Goodrich's declaration, which he relied on.
MR. HANNAH: In Good- -- in Goodrich's declaration. Counsel, this is a complete waste of time and, frankly, money asking him questions about

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whether drawings infringe the claims when he offers a 15-page dec on secondary considerations. All of these questions are completely outside the scope and unusable in this proceeding.

MR. TOMASULO: Okay. It's your opinion.

Q Can you answer my question, please?

A So the entirety of the '147 patent specification would inform a person of ordinary skill when attempting to understand what claim six means, and figure 5B is one part of the entire specification that would be reviewed when attempting to understand, you know, what claim six is claiming.

Q So you can't apply it right now? That's beyond the scope of what you're able to do?

A If I were -- if I were to attempt to understand claim six, I would not focus specifically on figure 5B.

Q Okay. But when you say attempt to understand claim six, do you understand claim six?

A I do understand claim six.

Q Okay. And you've charted claim six, in fact, right?

A Yes.

Q And you have said that all of the limitations of claim six are met by the Sony

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PlayStation, correct?

A I've said that each of the limitations in claim six maps to functionality identified in the PlayStation products, and as such it's highly likely that the PlayStation product is practicing the invention.

Q Okay. So let's look at claim six. What -- what do you understand the term "a method for healing a disconnection of a first computer from a second computer" -- what do you understand that to mean?

MR. HANNAH: Objection. Form.

THE WITNESS: So that means that this claim is referring to a disconnection method and a healing that takes place in communication between a first and second -- first and second computer where the disconnection has taken place over the broadcast channel.

BY MR. TOMASULO:

Q Okay. And the computer is being connected to a broadcast channel.

What is a broadcast channel?

A So a broadcast channel overlays an underlying point-to-point communications network and is used by two computer nodes in the network for

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broadcasting messages between them.

Q Okay. And so it says the broadcast channel is m -- is an m-regular graph where m is at least 3.

What does that mean to you?

A So an m-regular graph is a graph of nodes and links between those nodes in which each node is connected to m other nodes directly using m separate links, and in this particular context of claim six the number for m is 3 -- or at least 3.

Q Okay. Meaning 3 or greater?

A Three or more, yes.

Q And can that include all numbers that are 3 or more?

MR. HANNAH: Objection. Form.

THE WITNESS: M would include all integers that are 3 or greater.

BY MR. TOMASULO:

Q Okay. What's the minimum number of computers it takes to form a 3-regular graph as claimed -- or 3-regular broadcast channel as claimed in claim six?

MR. HANNAH: Objection. Form.

THE WITNESS: The minimum number of links or nodes; is that your question?

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BY MR. TOMASULO:

Q Nodes.

A Nodes. The minimum number of nodes in a 3-regular graph is your question?

Q Correct.

A That would be four nodes.

Q Okay. So is it your opinion -- now, if you have three nodes -- if you have four nodes and it's 3-regular, that's a complete graph, right?

MR. HANNAH: Objection to form.

THE WITNESS: Generally speaking, yes.

BY MR. TOMASULO:

Q Okay. So is that an -- is that -- does that meet the term of this claim that the m-regular -- that -- in other words, does that meet this limitation if the broadcast channel has four nodes and this 3-regular? Does that meet the term -- this term here?

MR. HANNAH: Objection. Form.

THE WITNESS: That would be one possibility.

BY MR. TOMASULO:

Q So it does -- it can meet it, in other words? I'm not saying it's the only thing that meets it. But in your opinion a -- a broadcast

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channel that has four nodes that is 3-regular meets that limitation?
A If you pull that limitation out and look at it -- looking at it stand-alone without the context of the rest of claim six, then, yes, that's true.
Q Okay. What is the minimum number of nodes that is required to perform claim six --
MR. HANNAH: Objection. Form.
BY MR. TOMASULO:
Q -- nodes or computers?
A That's going to take some thought because in claim six you have a broadcast channel that exists in three different states. There's the state before disconnection. There's the state during disconnection, and there's the state after disconnection. And the number of nodes in the -- in the different states can be different. So I'd have to think about that.
Q Okay. So if we look at figure 5B, does this -- does this 5B represent the three states that you described: The state before the disconnection would be when H is connected to I, A, F, and E; and the state after disconnection would be there are new connections between I and E -- I'm sorry -- I and F

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and A and E?
A So figure 5B is a snapshot of the network and is not really depicting a sequence of operations that's happening within different states of the network.
Q What does the phrase "may attempt to send a message from the first computer to the second computer" -- what does that mean?
MR. HANNAH: Objection to form.
THE WITNESS: So that's the first part of the method that is described in claim six where an attempt is made to send a message from one computer to another one.
BY MR. TOMASULO:
Q Okay. And then what is the next -- the next element -- it says: "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."
Do you understand that element?
A Yes.
Q Okay. And what -- what do you understand that element to require?
A This claim element is, generally speaking,

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saying that the attempt to send the message, which was described in the first part of the method, is unsuccessful, then the first computer will broadcast a type of message that is called a connection port search message to indicate that this first computer needs a connection.
Q What's connection port search message?
MR. HANNAH: Objection. Form.
THE WITNESS: So a connection port search message is a type of message that the first computer will send to indicate that it needs a connection.
BY MR. TOMASULO:
Q What is port? Do you know what that term means?
A In what context?
Q In the context of this claim.
A So the word "port" falls within the claim term "connection port search message," which is a claim term that is described in the patent specification.
Q What is a port in general computer science terms?
MR. HANNAH: Objection. Form.
THE WITNESS: So as a general matter, a -- the generic term "port" would refer to a -- an

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identifier for use in identifying connections to a network node.
BY MR. TOMASULO:
Q And one example of a port is a TCP/IP port, right?
MR. HANNAH: Objection. Form of the question.
THE WITNESS: A TCP/IP port is generally a socket identifier at the TCP level that identifies TCP connections.
BY MR. TOMASULO:
Q The TCP/IP protocol allocates something like 65,000 ports, right?
A The --
MR. HANNAH: Objection. Form.
THE WITNESS: The port number is a 16-bit number. And -- which means that the port number can take any of 2 to the 16 possible values, theoretically.
BY MR. TOMASULO:
Q Let's go to column 6 of the patent, line 10.
A Which column again?
Q Six.
A Okay. Column -- line 10?

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Q Yeah.
A Got it.
Q "Each computer connected to the broadcast channel allocates five communication 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 channel are sent."
What's your understanding of what's meant here?
MR. HANNAH: Objection to form.
THE WITNESS: So what this sentence is attempting to -- to convey to a person of ordinary skill is that the computers that are part of the broadcast channel, through their connections to the broadcast channel, will maintain five identifiers of communication ports that are used for communicating with other computers.
BY MR. TOMASULO:
Q Okay. And those are going to be the messages through which the broadcast channel messages are sent, right?
MR. HANNAH: Objection. Form.
THE WITNESS: So the computers will use those five different identifiers to identify the

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connections to the other computers in the broadcast channel that it's directly connected to.
BY MR. TOMASULO:
Q And if we go to the next paragraph, it says: "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."
Do you see that?
A Yes.
Q Then it says: "TCP/IP protocol provides for reliable and ordered delivery of messages between computers."
Do you see that?
A Yes.
Q And "TCP/IP protocol provides each computer with a port space that is shared amongst all the processes that may execute on that computer," right?
A Yes.
Q And so this is a type of port, a TCP/IP port or port space?
A Yes.
MR. HANNAH: Objection to form.
//

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BY MR. TOMASULO:
Q And those TCP/IP ports are identified by numbers 0 to 65,535, right?
A Yes.
Q Okay. Does the patent talk about any other types of ports?
A I haven't looked at the specification with that question in mind. I don't know.
Q What other types of ports can you identify?
A In what context?
MR. HANNAH: Objection to form.
BY MR. TOMASULO:
Q Computers.
A Not boating or wine?
Q Or wine. Not that either.
MR. HANNAH: Objection. Form. Outside the scope.
THE WITNESS: Again, without having read through the entire specification with that in mind, the things that come to mind are, for example, what the patent describes in column 1, the UNIX pipes. There are TCP/IP ports, and then there are also UDP ports as three possibilities.
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BY MR. TOMASULO:
Q Okay. So each of those could establish a port or has port space; is that right?
A Each one of those networking protocols --
MR. HANNAH: Objection. Form.
THE WITNESS: Each one of those network protocols would have within it the concept of a port.
BY MR. TOMASULO:
Q Okay. Anything else you can think of that could be a port, as described in the patent?
A So there are other network protocols which also have this concept of a port that's used for point-to-point communications.
Q Such as ...?
A Frame relay or ATM or X.25 or IPX or S&A and probably a few others.
Q Okay. If you go to Dr. Goodrich's declaration back on page 21 of his declaration, paragraph 44, do you see: "When each of H's computers --" I'm sorry. "When each of computer H's neighbors discovers that H has disconnected, it broadcasts a port connection request, indicating it needs to fill an empty port," right? Do you see that?

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A Yes.
Q And if we go back to the patent, we see that if we go to par- -- column 9, line 31, 32, 33, it says: "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."
Is it a requirement of claim six that the port connection request be broadcast on the broadcast channel and indicate that there -- that the broadcaster has one internal port that needs a connection?
MR. HANNAH: Objection to form.
THE WITNESS: I don't remember those exact words being used in claim six.
BY MR. TOMASULO:
Q Okay. It says -- next it says: "The port --" this document, column 9, says: "The port connection request identifies the call-in port of the requesting computer."
Is it a requirement of claim six that port connection request -- would it identify the call-in port of the requesting computer?
MR. HANNAH: Objection. Form.

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THE WITNESS: I don't -- I don't remember that exact language being used in claim six. I don't think it appears there.
BY MR. TOMASULO:
Q What -- is -- what -- what do you think "connection port search message" means?
A Well, to give an accurate definition of "connection port search message," I'd have to go back through the specification with that question in mind to provide a precise answer. In reading claim six, it's clear to me that a connection port search message is a message that the first computer sends to indicate that it needs a connection.
Q Okay. And when we go back to paragraph 24 of your declaration on page 7, do you understand what the term "edge" means?
A You said page 7, right?
Q Page -- I'm saying on page 7, paragraph 24 of your declaration where you say that the -- you've -- you've offered the definition of the term "connection" and "connected."
A Yes, I see that.
Q Okay. What is an edge?
MR. HANNAH: Objection. Form.
THE WITNESS: So an edge is what I've been

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referring to as a link that exists between two network nodes in a broadcast channel.
BY MR. TOMASULO:
Q What is a link?
MR. HANNAH: Objection. Form.
THE WITNESS: A link is a communication pathway that's established between two nodes in the network.
BY MR. TOMASULO:
Q Are all communication pathways between two nodes a link or an edge?
A No.
Q Okay. How do we separate the communication pathways between two nodes that are an edge, in your view, and those that are not an edge, in your view? Is there a rule that you apply?
MR. HANNAH: Objection. Form.
THE WITNESS: Yes, so within the context of the point-to-point communications network, an edge would form a direct link between the two nodes that are in the point-to-point communications network, irrespective of any underlying -- any -- irrespective of any -- any underlying equipment in the pathway.
//

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BY MR. TOMASULO:
Q Okay. I'm not -- so the edge refers to the point-to-point direct link that is made in the point-to-point network? Am I following?
MR. HANNAH: Objection. Form.
THE WITNESS: So in the point-to-point communications network there are a number of nodes, and those nodes are linked or connected to one another using lines that we call links or edges that form direct connections between the nodes in the point-to-point communications network.
BY MR. TOMASULO:
Q Okay. And are those different than the edges that you talk about in paragraph 24 or are those the edges?
A Those are the edges.
Q So an example of an edge would be a TCP/IP connection?
MR. HANNAH: Objection to the form of the question.
THE WITNESS: An example of an edge would be a link between two network nodes in a point-to-point communications network.
BY MR. TOMASULO:
Q And could that be a TCP/IP connection or

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not?
MR. HANNAH: Objection to the form of the question.
THE WITNESS: Two nodes in a point-to-point communications network can establish a link or an edge using the TCP/IP protocol to form those connections.
BY MR. TOMASULO:
Q So the presence of a TCP/IP link or edge would be evidence that the nodes were connected?
MR. HANNAH: Objection. Form.
THE WITNESS: The establishment of a link between two nodes and a point-to-point communications network means that those two nodes, as far as the underlying network goes, are connected, but it does not mean that -- for the broadcast channel that overlays the point-to-point communications network, it does not mean that they are connected at the broadcast channel.
BY MR. TOMASULO:
Q So it's irrelevant to whether they're connected at the broadcast channel?
MR. HANNAH: Objection. Form.
THE WITNESS: I would say they're different things. The broadcast channel overlays

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the underlying point-to-point communications network, and, as such, there could be communications formed in the point-to-point communications network that are not part of any broadcast channel.
BY MR. TOMASULO:
Q But is it correct that all of the connections that are formed between two application programs that form an edge, that those will also be reflected by a link at the point-to-point network?
MR. HANNAH: Objection. Form of the question.
THE WITNESS: So I -- within the context of what the '147 patent specification is describing, two application programs are connect through the logical broadcast channel, which is different than a connection at a point-to-point communications network level.
BY MR. TOMASULO:
Q And so what does it take for them to be -- not -- not all application programs are -- have an edge between them, right?
A That's not necessarily the case.
Q Okay. So not -- they don't -- all application programs don't have an edge between them, right?

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A They may or may not.
Q Okay. And is it detectable -- what -- what -- I mean, I'm assuming that it's a requirement of the claim that there be an edge, right; otherwise, it's not connected?
MR. HANNAH: Objection. Form.
THE WITNESS: The claim requires for m to be at least 3.
BY MR. TOMASULO:
Q The computers need to be connected to a broadcast channel, right?
A Yes.
Q Okay. So not all computers are connected to all broadcast channels, right?
A It is certainly possible for computers in the point-to-point communications network to not be part of the broadcast channel.
Q Okay. So how do you determine whether a computer is connected to the broadcast channel? What indicia is there? What evidence would there be that would allow an expert like you to say this one is connected and this one is not?
A You'd have to look at the broadcast channel itself, which is overlaid over the point-to-point communications network.

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Q So what -- what would you look -- what would be an example of how you would do that? How would you look for a broadcast channel? You said you would have to look at the broadcast channel. How would you find one?
A So as I had mentioned earlier, a broadcast channel is implemented as an overlay at a higher layer than the point-to-point network protocol that underlies it. So that implementation of the broadcast channel would establish connections between computers at the level of the broadcast channel, and it's those connections that are formed by the broadcast channel, which is existing at a layer higher than the point-to-point communications network. It's those connections that you would have to look for.
Q And how would you do that?
A By examining the function and operation of the network nodes at the -- at the -- at the level of the broadcast channel.
Q And how would you do that?
MR. HANNAH: Objection. Form.
THE WITNESS: Through a variety of methods. Through the depositions of witnesses. Through the examination of technical documentation.

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Through the examination of publicly available documentation. Through looking at source code. Through a wide variety of statements that are made in licensing agreements. Through all kinds of things.
BY MR. TOMASULO:
Q What about testing?
A Through -- physical testing is also one of the possibilities for evidence to examine, yes.
Q Okay. So how would you test for the presence of a broadcast channel that meets the limitations of the claims?
MR. HANNAH: Objection. Form. Outside the scope.
THE WITNESS: It depends on the product that I'm examining how the test would be set up.
BY MR. TOMASULO:
Q Okay. But you could use a -- the Wireshark, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Depending on the particular product I'm looking at, possibly.
BY MR. TOMASULO:
Q Okay. And so you've talked about the license between Sony and Boeing as being irrelevant

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to the validity of the patents; is that right?
A I have talked about the license between Sony and Boeing as an indication that the '147 patent is nonobvious.
Q And what is the thought process there? Why does somebody taking a license have anything to do with the nonobviousness or obviousness of a patent?
A Well, because if the patented invention was truly obvious, then there would be no need to take a license.
Q Okay. Couldn't someone take a license for a matter of convenience to avoid litigation?
MR. HANNAH: Objection to form.
THE WITNESS: It's possible for someone to take a license to avoid litigation. There's a feeling that -- if there's a feeling that it's likely that their products infringe.
BY MR. TOMASULO:
Q Okay. So that's the only circumstance that you think someone could take a license?
A That's one possibility.
Q Okay. Are all the patents -- so how many patents were licensed in the Sony agreement; do you recall?

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A I remember that it was a portfolio, but I don't recall the exact number.
Q And your -- your testimony is that the licensing of the portfolio means that the '147 patent is valid?
A The licensing of the portfolio, which includes the '147 patent, is an indication that it is likely that the licensee believes that their product may infringe the '147 patent.
Q There's no services associated with the license, right? It's a bare license? Just you get the patents and that's it, right?
A As far as I understand, it's a license that allows the invention to be practiced.
Q Okay. And there was two -- the six asserted patents and then some other patents as well, right?
A I don't remember the exact number, but I do know that there were several patents involved in that licensing agreement.
Q And not all of them are asserted here, right? You know that? Two weren't?
A As far as I understand, there are only two patents going through these IPR proceeding.
Q Well, you also offer testimony as to three

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other patents, right? So there's at least five patents going through the IPR proceedings.
A So for what I understand --
MR. HANNAH: Objection. Form. Outside the scope.
THE WITNESS: From what I understand, I'm only being deposed on two patents going through the IPR proceedings.
BY MR. TOMASULO:
Q That is correct. But what I'm saying is that there are -- let me ask a different question here.
So is it possible that one of the patents was the only patent that Sony wanted? Have you -- have you done anything to investigate that?
A I have not seen any evidence to suggest that.
Q Okay. And you haven't had an opportunity to look at the licensing history or any correspondence between Sony and Boeing, right?
A I have not seen anything in the evidence that I've looked at to suggest your hypothetical.
Q Well, no. My question was a different question. I said you haven't had an opportunity to look at the licensing history or any correspondence

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between Boeing and Sony, right? You haven't looked at that?
A Not outside of what I've disclosed as evidence that I've relied upon.
Q And so the -- the -- do you consider the value paid, the 750,000 or whatever it is that's -- I guess, 900,000, according to you, that -- do you consider that to be significant or insignificant?
MR. HANNAH: Objection. Form.
THE WITNESS: I have not made any determination of the significance of the dollar amount of the license itself.
BY MR. TOMASULO:
Q Okay. But if they took a license for a dollar, would that suggest to you that the patents were valid?
A Not necessarily.
Q Or if it -- you know, some other, I mean, nuisance amount that just says it's less expensive than these proceedings or maybe I might need them in the future, but if it's just nuisance money does it still make the case, in your -- by your way of thinking, that it is relevant to the obviousness analysis or does it have to be a license that is a fair market license, let's say?

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MR. HANNAH: Objection. Form of the question.
BY MR. TOMASULO:
Q Just any old license does the trick, in your book?
A So I have no opinion on what constitutes nuisance money and don't feel qualified to render an opinion on what would constitute nuisance money in a license agreement.
Q In your view -- so you can't say if this is nuisance money or not?
A So --
MR. HANNAH: Objection. Form.
THE WITNESS: It was not my role in this case to determine whether or not the amount of money in the license agreement was considered nuisance money, and I don't feel qualified to offer an opinion as to whether the amount of money in the license agreement is or is not nuisance money.
BY MR. TOMASULO:
Q Okay. So if it was nuisance money, then it really would be pretty immaterial to the obviousness of the patent; would you agree with that because -- so the dollar wouldn't, you know, mean that the patents were valid, right?

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MR. HANNAH: Objection. Form.
THE WITNESS: As far as I understand it, in license agreements there are a number of possible things that are negotiated in the agreement, potentially, in addition to simply cash transactions. But I have not read the license agreement with the -- with the question in mind as to whether or not the cash transaction would be considered a nuisance payment or not.
BY MR. TOMASULO:
Q Okay. Oh. But if it is a nuisance payment, then it really doesn't support the idea that the license makes the patent somehow nonobvious, right?
MR. HANNAH: Objection. Form.
BY MR. TOMASULO:
Q Let's say this --
A Well, as I said earlier, I'm not qualified to render an opinion on what's considered a nuisance money to begin with let alone base -- use that as a basis for an opinion.
Q But -- so if somebody gave Sony a free license, would you think that it made the patents somehow nonobvious?
MR. HANNAH: Objection to form.

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THE WITNESS: Not necessarily.
BY MR. TOMASULO:
Q Okay. So if it's -- if it's free, it doesn't -- it doesn't count towards the obviousness analysis, right?
MR. HANNAH: Objection. Form.
THE WITNESS: The amount of money was not the issue that I looked at in the license agreement. What I looked at in the license agreement was the fact that a license was taken for these patents for this '147 patent when Sony did not have to take the license in the first place. So the fact that they actually took a license is an indication that an analysis was likely performed by Sony and a determination was made that it is possible that Sony products are infringing the '147 patent.
MR. HANNAH: Is it a good time for a break?
MR. TOMASULO: Sure. Fifteen minutes?
MR. HANNAH: Sure.
MR. TOMASULO: How long have we been on the record?
THE VIDEOGRAPHER: Three hours, forty-five minutes.
Going off record at 2:28 p.m.

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(Recess.)
THE VIDEOGRAPHER: Back on the record at 2:45 p.m.
BY MR. TOMASULO:
Q One of the things you say in paragraph 31 is that it's your opinion that the increase in sales was due in part because of Sony's license to the '147 patent.
Do you see that?
A Yes.
Q Okay. And what's your basis for that statement?
A The basis of the statement is the time frame in which the license was taken was right before there was a ramp-up in sales of the PlayStation 3 product, which is likely to have included the '147 patent inventions based on the fact that that license was taken at that time, and then, given the sales increase which occurred afterwards, it's indicative that the incorporation of the '147 patent ideas was contributing to the commercial success of the PlayStation 3.
Q Do you have anything else that supports your opinion or is this just everything in this paragraph here?

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A It's just what's in this paragraph.
Q Okay. And did you make any effort to determine what other features were potentially driving sales?
A No.
Q And -- and so you don't really know if the sales were entirely attributable to other features that have nothing to do with the patent, right?
A Right.
Q And, for instance, do you know when Sony began including a Blu-ray player with its PlayStation products?
A What's the question?
Q Do you know when Sony began including a Blu-ray player with its PlayStation products?
A I don't know the exact time.
Q And can we agree that a Blu-ray player is not accused in this case?
MR. HANNAH: Objection. Form.
THE WITNESS: This case is an IPR petition. I don't know that --
BY MR. TOMASULO:
Q Can I -- can we agree that you have not opined that the significance of a Blu-ray player is connected to the '147 patent?

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A I have not looked at a Blu-ray player for secondary considerations of nonobviousness.
MR. TOMASULO: Okay. I'd like to mark as Exhibit --
THE REPORTER: 6.
MR. TOMASULO: 6.
(Exhibit 6 was marked for identification by the court reporter.)
MR. HANNAH: And while we're marking that, I'd like to designate for the record the transcript as Protective Order Material.
MR. TOMASULO: Okay.
MR. HANNAH: Can I get a copy?
MR. TOMASULO: Oh, yeah. I'm sorry.
Q Have you seen this article before?
A Yeah, I don't remember this.
Q Okay. If you look at the second page, there -- the first line here --
MR. HANNAH: I'm going to object to this exhibit as lacking foundation.
BY MR. TOMASULO:
Q Do you see where it says: "Even if you look past the price differences, the argument for buying a PS3 instead of current Blu-ray players are overwhelming"? Do you see that sentence?

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A Yes.
Q Okay. And PS3 means PlayStation 3, right?
A Yes.
Q Okay. Is this article saying that there's a good argument to be made that you should buy a PlayStation 3 and use it as a Blu-ray player, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Yeah, it appears this -- the author of this article is writing about the Blu-ray feature in the PlayStation 3.
BY MR. TOMASULO:
Q Okay. Then that's not something you considered, the desirability of this Blu-ray player in the PS3? That's not something you considered in forming your opinions, right?
A In forming my opinions I didn't look at the functionality of the Blu-ray player in the PlayStation 3.
Q Okay.
Next.
(Exhibit 7 was marked for identification by the court reporter.)
BY MR. TOMASULO:
Q So what's been placed before you is something that's been marked by your -- and it's

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referred to in your declaration as Exhibit 2016, 2-0-1-6.
Do you see that?
A Yes.
Q And that's been marked as Exhibit 7.
What is Exhibit 7?
A So Exhibit 7 is a chart that I created that consolidates the evidence that I relied on to show the -- that the Play- -- that there's a nexus between the functionality in the PlayStation product and the invention described in the '147 patent.
Q So you created this?
A Yes, in collaboration with counsel.
Q Okay. And then did you find the -- the exhibits and things like that that are identified in here? You have Exhibit 2029 and so on and so forth. Is that information that you, yourself, went out and found or was that curated and provided to you by -- by counsel?
A I don't know about "curated," but counsel did provide the links that are shown here in the claim charts.
Q I see. Did you do any independent investigation?
A I did not on my own investigate any links

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outside of what's in the claim chart.
Q Got it. Okay. So the information that you used to form your opinions as expressed in this claim chart was all provided to you by counsel, right?
A Correct.
Q Okay. And then you didn't go outside of that or look for anything else to validate or verify it, correct?
A Correct.
Q And you did not ever look or touch or physically play a Sony PlayStation product, correct?
A Correct.
Q And to confirm, you are now -- you have said that this is not actually an allegation of infringement. It's what you are saying is a nexus chart; is that right?
A Correct.
Q What do you mean here where you say: "The Sony PlayStation product meets the recited claim language because it includes functionality for healing a disconnection of a first computer from a second computer. The computer is being connected to the broadcast channel. Said broadcast channel being an m-regular graph where m is at least 3"?

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A So what I mean by that is that the evidence that I have cited in the chart in this exhibit -- that evidence describes at a high level how the PlayStation product functions, and it's clear from reviewing this high-level description of the PlayStation product functionality that the PlayStation product appears likely to implement what is described in claim six as a method for healing the disconnection of a first computer from a second computer that are connected to the broadcast channel.
Q Okay. And so the next sentence down says: "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."
What is the evidence that the Sony PlayStation product has this functionality? Do you cite any evidence for this sentence?
A So throughout the evidence in this chart, it appears that the Sony PlayStation product is designed to be used by at least three players. For example, on page 4 on the hypotheticals posed in the evidence suppose we have three players in a

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particular public bubble, which suggests, you know, that at least three players were envisioned to be -- to use the product, but throughout the evidence it's clear that the PlayStation product is designed to support, as it says on page 9, millions of players online at once, for example, which would be far more than what is required by a 3-regular graph.
Q Okay. So is there -- is there anything beyond the fact that it is capable, in your view, of allowing more than three players that supports the sentence here that we just discussed, the first sentence of the second full paragraph where you say that the Sony PlayStation product includes functionality for healing and so on?
A So, again, looking through the evidence, the evidence describes the ability of participants to merge with existing public bubbles and to disconnect from existing public bubbles to come and go from those public bubbles, each of which allows the participants within the bubble to broadcast communications to one another.
So the ability to disconnect from a public bubble and for that bubble to remain functioning, you know, as described clearly throughout the -- the evidence is an indication that it's highly likely

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that the Sony PlayStation product is performing the healing method called for in the '147 patent when a computer disconnects from a broadcast channel.
Q Any other evidence that supports your view that they're performing this healing connection -- healing a disconnection?
A There are numerous pictures in the evidence in the claim chart showing multiple participants interacting with each other in a common scene, and as a person of ordinary skill would understand, that for multiple participants residing at different nodes in a network to participate in a common scene, they would have to be part of a communications network between them, such as what the '147 describes as a broadcast channel that's overlaying the point-to-point communications network of the Internet.
Q Okay. Anything else?
A The -- in the claim chart evidence the Sony PlayStation product is described as having a matchmaker technology, and it's that matchmaker technology that's described as enabling the ability for network participants to connect and disconnect from these various bubbles in a seamless manner, which, again, shows a nexus between the PlayStation

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product and the method for disconnecting.
Q So is it your opinion that the method -- claim six is a method claim, or how would you describe it?
A Claim six begins by saying that it's a method for healing.
Q Okay. And then the method claim of claim six has three steps, broadly speaking, correct?
A It comprises three elements, yes.
Q Okay. And are you saying that the Sony PlayStation product actually performs these elements or are you just saying that you think it has some functionality that could allow it to perform these functions?
A Well, I'm saying --
MR. HANNAH: Objection. Form.
THE WITNESS: -- that, you know, the evidence shows Sony intends for the product to be used in a way that, as it appears, would implement the method described in claim six.
BY MR. TOMASULO:
Q So my question was are you saying that Sony actually performs the three elements of claim six or are you saying it has the capability --

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the mere capability of doing it? Let me ask you a different question.
Is it your opinion that Sony performs the three steps of claim six?
A So it's my opinion that it's the Sony products, such as PlayStation 3, that those products perform the method that's described here in claim six because of the appearance of a nexus between what Sony describes their PlayStation product as doing and the method for healing.
Q Okay. So let's go to the next sentence. You say: "This functionality controls players disconnecting from a game session and attempts to heal a game session by making new connections."
What functionality are you talking about?
A Well, for example, I mentioned earlier the matchmaking technology that is described in the evidence as one example of the functionality that I'm talking about.
Q Any other examples?
[Pause.]
Are you going to be required to read the whole thing to answer my question?
A No, I'm just trying to make sure that I don't point to stuff that's redundant with what I've

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said earlier.
But, for example, on page 11 there's a description of what's called a mesh-based network, and in that description of a mesh-based network it's describing, you know, a pool of players, a matchmaking that occurs amongst that pool of players in this mesh network. And as part of -- of forming this mesh network based on play- -- people who are, quote, physically located near you, the network would necessarily have a capability of deciding not only who should be part of the broadcast channel, but who should not be part of the broadcast channel, which means it would have the ability to both allow for as well as to force disconnections of nodes from a particular broadcast channel.
Q Okay. So it says here, going back to the page 1 of your chart that you prepared -- it says: "The match server, host server, or peer will communicate with another player that had an established communication channel with the disconnecting play --" I expect he means the player. It says "play."
A "Disconnecting player," yes.
Q Okay. And that can be connected to the game session to maintain and optimize game session

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or match and to create an optimized connectivity mesh of players."

What do you mean here?

Let me see if I can ask a shorter question.

Do you see that sentence and did you write that? The one I just read, did you write that?

A Those are my thoughts about the Sony PlayStation product, and this was actually written in conjunction with the attorneys.

Q Okay. And so you say that the match server, host server, or peer -- do you mean that all of those three do that -- do the rest of this sentence or do you mean one of the three might do it? What do you mean when you've identified three things: match server, host server, or peer?

A Well, the match server, host server, and peer are part of the broadcast channel, and, as such, because they are part of the broadcast channel, they are communicating with other players and are -- and are part of the method for healing a disconnection. So any one of those three can be used for communicating with another player.

Q Okay. So those three are part of the broadcast channel, and they -- one of them will

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communicate with another player that had an established communication channel with the disconnecting player. Okay.

And so are you saying that the -- the match server, host server, or peer will communicate with another player that is already a member of the broadcast channel?

A Yes.

Q Okay. And that -- and then it says: "that can be connected to the game session to maintain an optimized game session." What do you mean by that? If it's already connected to the broadcast channel, what other connection does it need to make?

A So if a particular node was connecting with another node over the broadcast channel and suddenly that link were to go away and -- which is called disconnection, then the packets would have to get rerouted through another means to reach that destination node because that link that was connected has now gone down. So that rerouting of the communications through other parts of the broadcast channel is what's described here so that the game session can continue.

Q Now, if it's a full mesh, you wouldn't

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need to do any of that, right? If someone leaves, it's still a full mesh? Someone joins, they make a connection to everybody, it's now a full mesh; is that right?

MR. HANNAH: Objection. Form.

THE WITNESS: So if a node leaves a -- a network, it's not necessarily true that all of the links will be considered down at the same time. The network will react to the disconnection of the node potentially at different times for different lengths, and, based upon that, will figure out how to heal itself as it goes through that transient state before settling in on a final state of the network topology.

BY MR. TOMASULO:

Q And does that happen in all networks or just the Sony PlayStation product? The way you said it it sounded pretty general.

MR. HANNAH: Objection. Form.

THE WITNESS: That's just due to the nature that the network nodes are distributed and not synchronized in all of their actions so that if a network node goes down, it is not necessarily true that all the other nodes in the network will respond in perfect synchrony to that disconnection across

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all of the links that were connected to the node that went down.

BY MR. TOMASULO:

Q Okay. And then you say that -- and it's your opinion that the Sony PlayStation works that way, the way you've just described as general node, you know, synchronization?

A I'm saying this as a general matter as a person of ordinary skill, understanding how network communication works across distributed nodes, that those nodes are typically not time synchronized. So they respond to events in the network at slightly different times, which means there's a transient period of time before the network nodes all figure out that a particular node is disconnected and adjusts their communications. And once that has -- transient time has expired, then the network is in a steady-state condition.

Q So are you saying that you believe that the alleged use of the claims occurs in this transient condition?

MR. HANNAH: Objection. Form.

THE WITNESS: I'm saying that during this transient period the -- the node that is disconnected from the network invokes a procedure or

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a method in the other nodes to handle that disconnection before the network settles down into its final steady-state condition of connectivity.
BY MR. TOMASULO:
Q I'm sorry. Are you saying that the Sony PlayStation does this or are you just talking about general networks?
A I'm talking in general about how communication networks happen between nodes such as the PlayStation products operating over a point-to-point communications network, such as the Internet.
Q Okay. So you don't know if this happens in the Sony PlayStation networks or not? You just -- it's just a general comment?
MR. HANNAH: Objection. Form.
THE WITNESS: I'm just saying, as a person of ordinary skill who understands how these networks work, it's -- it's highly unlikely that the PlayStation products operate in any other way than in an unsynchronized mode when a particular node is disconnected -- disconnecting all of its links from the network.
BY MR. TOMASULO:
Q Okay. So -- so now we have the -- it says

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here in your sentence -- it says that the -- the match server will -- host server or peer will communicate with another player that already had an established communication to the channel -- so it's someone who is already in the channel -- with the disconnecting player 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.
What does that mean and how does that pertain to the claim? What -- why does that have anything to do with the claim limitations?
A Well, certainly if your graph is no longer an m-regular graph due to the disconnection of a node, you have a suboptimal graph. The -- the optimal graph will be the m-regular graph in which every node has the same number of connections to other nodes.
Q Okay. So, now, in your view does this claim require that the m-regular network be incomplete?
A There's nothing in the claim that says the m-regular graph must be incomplete.
Q Okay. So when you're referring to m-regular graphs in this chart, are you referring to

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m-regular graphs that are what we call a full mesh, where every node is -- where it's a complete network? Is that what you're referring to when you talk about an optimized connectivity mesh of players?
MR. HANNAH: Objection. Form.
THE WITNESS: What I mean by optimized connectivity mesh of players is that every node is connected to m other nodes in an m-regular graph.
BY MR. TOMASULO:
Q And why is that considered an optimized connectivity mesh of players?
A Because the optimal connectivity for the players in a broadcast channel is for every player to have a connection to m other players in the broadcast channel.
Q Okay. Optimized according to whom? You?
A It's optimized because when all of the players are connected to m other players, then that minimizes the maximum distance that messages need to traverse in order to reach all parts of the broadcast channel.
Q So in a ten-person network m would be nine, then, right, to make it an optimum network? That would be the minimum number of hops, correct?

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MR. HANNAH: Objection. Form.
THE WITNESS: No, I'm not -- I'm not saying anything about whether the graph is complete or not -- incomplete. I'm simply saying every node needs to have m connections to other nodes in order to minimize the -- the maximum distance that a packet needs to travel to reach any part of the broadcast channel.
BY MR. TOMASULO:
Q Okay. But wait. If it's a full mesh, the minimum packet distance is one, right?
A That's true.
Q Okay. So that would be optimum, right? One, that's the smallest possible number?
MR. HANNAH: Objection to form.
THE WITNESS: For that particular hypothetical, that's true.
BY MR. TOMASULO:
Q Okay. So the smallest number of hops you can ever have is one, and that's optimal, right?
MR. HANNAH: Objection. Form.
THE WITNESS: But, again, you have to -- you have to realize that there may be situations in which the nodes cannot maintain connections with all other nodes in the broadcast channel.

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BY MR. TOMASULO:
Q And that might not be optimal, but if they can, then that's a full mesh network and that has a diameter of one, right? That's the smallest possible diameter?
A Well, I don't see how this example relates to what I was describing earlier. I think it's --
Q I'm using your words. You said that the -- that you want to have -- that optimal refers to having the smallest distance between two nodes, and I said then doesn't that make a full mesh optimal because that has the smallest distance. You've agreed with me --
MR. HANNAH: Objection to form.
BY MR. TOMASULO:
Q -- correct?
A I think you've jumped to a different context from what I was describing earlier. What I was describing earlier was a context in which all of the nodes in the network had the same number m of connections to other nodes, and in that context the graph could be incomplete or it could be complete.
So in the case where the graph is incomplete, if some nodes had less than m connections to other nodes, then the maximum

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distance to the other nodes in a network is not necessarily optimal, and it's only optimal when all the nodes have the same number of connections.
Q So what you said was it's -- I said optimized according to whom? You? And you said it's optimized because when all of the players are connected to m other players, then that minimizes the maximum distance that messages need to traverse in order to reach all parts of a broadcast channel.
So what -- I gathered what you were saying is that we want to minimize the distance that a message needs to travel to reach all parts of the broadcast channel, correct?
MR. HANNAH: Objection. Form.
THE WITNESS: And that would be true under both scenarios of a complete graph as well as an incomplete graph.
BY MR. TOMASULO:
Q Okay. But it -- under -- if the optimization is to get the shortest path between any two nodes, then the optimum network is a full mesh network as that has a maximum distance of one. All nodes have a direct connection to every other node, right?
A Only --

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MR. HANNAH: Objection to the form of the question.
THE WITNESS: Only within the context of a fully connected graph is that true.
BY MR. TOMASULO:
Q Right. So when it's a full mesh, you have a maximum distance of one, and you said that's an important factor, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Only for the context of a fully connected graph is that true.
BY MR. TOMASULO:
Q Okay. And so you go on to say: "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 session or match and to create an optimized connectivity mesh of players."
Now, what happens if a node leaves a full mesh complete network? What happens then? How does this claim get performed?
A So when a node leaves a full mesh network due to an unplanned event, such as a power outtage, then the other nodes in the network must learn that the node has left the network, and that will happen

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at different times for different nodes in the network because the nodes in the network are not synchronized to learn about the disconnection at the -- at exactly the same time all throughout the network. So for that reason, there is a transient period of time in which the knowledge of the departure of a node percolates through the network before the network settles on its final steady-state configuration with the absence of that node.
Q But in a full mesh network, okay, do you -- can you look at 3A and 3B of your patent? Are you there?
A Yes.
Q Okay. So let's -- 3A is a full mesh, full regular network, correct?
A Yes.
Q Okay. So explain to me what 3A would look like after the performance of the claim and explain to me how that would work.
MR. HANNAH: Objection. Form and outside the scope.
THE WITNESS: So 3A is a narrow example of the full scope of what's possible in the claim, but in the 3A scenario, if one of the nodes were to have an unplanned event to disconnect it from the

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network, then that means that all of the four links that were previously established between that node and the other four nodes in the network would also be disconnected, but knowledge of that disconnection would not be known to the other four nodes at exactly the same time. So as the other nodes learn of the disconnection and reroute information accordingly, there is a transient period before you would result in a steady-state situation with four nodes in the network where each node has three connections to the other nodes.
BY MR. TOMASULO:
Q Okay. And so in that instance would you have viewed the claim to be performed, what you just described?
A I would --
MR. HANNAH: Objection. Form.
THE WITNESS: I would need more information to determine that.
BY MR. TOMASULO:
Q Well, it says the -- let's go back to the claim language, and it talks about it needs to be m-regular where m is at least three at the beginning, right?
A Okay.

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Q Okay? And then at the end it says: "so as to maintain an m-regular graph," right?
A Okay.
Q So in this example, the one we just described, we would have gone from a 4-regular graph to a 3-regular graph, correct?
MR. HANNAH: Objection. Form.
THE WITNESS: For that particular example, that's what would happen, yes.
BY MR. TOMASULO:
Q Okay. So now m was -- and so is it your opinion that m can change during the performance of the claim? In other words, at the beginning it's a 4-regular graph, and now you say to maintain an m-regular graph and now it's a 3-regular graph. Has it been maintained as an m-regular graph or not?
A As long as m is --
MR. HANNAH: Objection. Form.
THE WITNESS: -- is at least 3, yes.
BY MR. TOMASULO:
Q So m can change during the performance of the claim? That's your opinion?
MR. HANNAH: Objection. Form.
THE WITNESS: M simply needs to be at least three. That's all the claim requires.

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BY MR. TOMASULO:
Q It doesn't need to be the same m at the end of the graph as at the beginning, right? That's what you're saying?
MR. HANNAH: Objection to form.
THE WITNESS: I don't see anything in this claim that says m has to be a particular number throughout the entire method.
BY MR. TOMASULO:
Q Okay. So removal of a node from a full mesh network, which would take it to -- when you remove a node from a full mesh network, it will decrease the regularity of the network by one, correct?
MR. HANNAH: Objection. Form.
THE WITNESS: If you start with a -- a complete graph and one of the nodes is removed from the complete graph, then the size of the network is reduced and the number m decreases by one.
BY MR. TOMASULO:
Q Right. Okay. And then if you look at the example on 5 -- 5B, right, that has nine nodes, correct, at the beginning, if we assume this was -- that H was involved in this beforehand, which is what they've described?

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A So 5D shows eight nodes.
Q 5B shows nine nodes? Well --
A 5B.
Q 5B. Yes. I'm sorry.
A Okay. 5B. 5B there are nine nodes.
Q It's showing the departure of node H, right?
A Well, it shows nine nodes, and it shows one node H without any connections.
Q And if you read the -- are you aware that this was a representative example of an unplanned departure? If you're not -- if you're not familiar with this figure, that's fine. Let's just go back to your charts. It sounds like you don't remember this figure.
So going back to the first page of your charts, you say the functionality creates m-regular topologies of players when setting up logical and physical network topologies.
What do you mean by m-regular topologies of players?
A So the Sony PlayStation product allows for a particular network node to engage in multiple broadcast channels simultaneously, each one of those broadcast channels being an m-regular topology

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within -- that overlays the underlying point-to-point communications network.
Q So each of these topologies that you've identified below is an m-regular topology?
A No. What I'm saying is that an m-regular topology may be, for example, associated with, as shown in the slides, a public bubble within which multiple participants are able to communicate, but a particular node can have multiple of these occurring simultaneously, each one with its own topology so that a network node is not necessarily only associated with one broadcast channel at a time but may be associated with a plurality of broadcast channels at a given time, each broadcast channel representing an m-regular topology.
Q Okay. So can you identify for me every broadcast channel that you have determined to be an m-regular topology? Let's just list them off, and then we can go through why you know that they are m-regular topologies. Can you do that?
A So in this char I have not proven that the PlayStation product definitively has an m-regular topology. I'm simply saying that the evidence shows there's a very high likelihood that there is an m-regular topology in the product based on the way

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in which the products are described in this evidence.
Q Okay. So -- but what -- what is -- what's a -- what are the broadcast channels that you believe are highly likely to be m-regular? Can you just tell me the broadcast channels because I need to know what they are and what they comprise. What are the participants? What are the edges? How do we find them? We need to verify what you say.
A The -- there's quite a bit of evidence in these charts describing these topologies. If you --
Q No, no, no.
A -- for example, look at the very next page, page 2, you can actually see a plurality of, for example, public bubbles and users associated with public bubbles through activity hosts such that any particular user can be associated with more than one at the same time and -- which is a capability of the product that's being described, which allows for multiple users not only to be associated with a given public bubble, but for multiple public bubbles to be associated with a given user.
Q Can you identify -- let's just start with one. Just identify one broadcast channel with specificity that you believe is an m-regular

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topology. So just identify one. There are so many. It shouldn't be a problem.
A So as I've outlined here, you know, the public bubble topology is a topology for a broadcast channel.
Q Okay. So are all of these -- there are one, two, three, four, five, six, seven, eight -- I don't know if the -- what are the participants in the broadcast channel that you're looking at on page 2? So let's go through that. And show me how that's m-regular.
A Well, as I said before, I have not done a detailed analysis to prove definitively that the evidence shows an m-regular graph. I am simply saying that the evidence shows that it is highly likely that the products are practicing the '147 invention, including it is highly likely that within the accused products one would find an m-regular graph if one were to do the discovery work necessary to examine those products.
Q So is it -- is it correct that this actually -- your -- your chart here that you've reproduced on page 2, that doesn't show an m-regular graph, right?
MR. HANNAH: Objection. Form.

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THE WITNESS: It is not proving that an m-regular graph exists; that's correct.
BY MR. TOMASULO:
Q Okay. And -- and it doesn't show where -- there's no -- is there any member of the broadcast channel here that has more than three connections?
A So this is a simplistic example, as I've said earlier, and the evidence --
Q I'm sorry. My -- my -- I just wanted an answer to my question. I mean, you will have an opportunity for redirect. So this is really a cross examination, which I know as a savvy expert witness you've experienced that this isn't a deposition. This is a cross-examination. This is my time. I'm not trying to be rude, but I do want to proceed through my questions, and your -- your counsel will have every opportunity to ask, you know, the kinds of questions that you would like to talk about. But with time being short, I respectfully would like just to get answers to my questions, please.
A So as I was attempting to say --
MR. HANNAH: Well, objection. There's no question pending, and, Counsel, let's avoid the argumentative comments on the record. There's no place for that.

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MR. TOMASULO: Could you please re-read my question.
(Record read by the reporter as follows:
"QUESTION: Okay. And -- and it doesn't show where -- there's no -- is there any member of the broadcast channel here that has more than three connections?")
THE WITNESS: So in this simplistic figure that's shown on page 2 there are a number of -- I think I count four different end user nodes that are connected into the world server cloud, but as we know from the evidence that I've presented in this chart, that the PlayStation product works with up to a million players participating with each other through the server cloud. So you can't put a million boxes on this figure and have it be intelligible. So for sake of simplicity, only four were listed, but that doesn't mean the product is limited to only four players interacting at the same time.
BY MR. TOMASULO:
Q Okay. So you speculate that if you just had more players here, you might be able to draw a broadcast channel that meets the limitations of the

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claims? Is that what I'm getting?
MR. HANNAH: Objection. Form.
THE WITNESS: So -- so what I'm saying is that it's pretty clear to a person of ordinary skill that the topology as shown in this figure is not the only possible topology that's possible using the PlayStation products and that many other are possible, including topologies in which there are more than four players.
BY MR. TOMASULO:
Q Does this show a single topology or, I mean -- I'm sorry -- multiple broadcast channels? one broadcast channel? How do I determine who the participants are and what constitute the edges here?
MR. HANNAH: Objection. Form.
BY MR. TOMASULO:
Q Okay. This is your chart. Let me ask you to explain it.
A I think --
Q What -- how many -- are all of the -- there's nine boxes here, right?
A Yeah.
Q Okay. Are they all participants in a single broadcast channel?
A I think what's clear here is that of these

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nine boxes, as you say, one of them is just labeled "World Server," which is simply a label referring to the cloud.
Q So --
A The idea --
Q So that box is not --
A Yeah, but the other eight boxes are describing activity hosts and physics hosts and physics clients, all of which are network nodes that exist in the -- in these public bubbles that are forming broadcast channels.
So as you can see from this figure, for example, the physics client is able to communicate with a public bubble labeled "Hell Mouth" and is also able to communicate with activity host patrol through which the physics host "Deborah" connects to the other public bubble "Archers Line."
So one network note is able to communicate with more than one public bubble or broadcast channel, for example, but, again, this is a simplistic figure and is not representative of all the ways in which the PlayStation product is used over the Internet to allow up to millions of players to interact.
Q Okay. So -- but are all eight of these --

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so we've eliminated the "World Server" as a potential participant -- is that right? -- because it's -- you said it was just a representation of what these top four bubbles are?
A The top four bubbles, if you discount the "World Server" box -- the top four boxes are inside this Internet cloud and are communicating with participants in the bottom four boxes.
Q Okay. And so what are the different -- are there -- is this -- are all eight of these other boxes -- are they participating in a single broadcast channel or are there multiple broadcast channels being represented here?
A So what's being represented here is shown at least two broadcast channels.
Q Okay. What are they?
A The public bubble that's labeled "Hell Mouth" and the public bubble named "Archers Line."
Q And -- but "Mission Activity Host Strike" and "Mission Activity Host Patrol" -- those are not broadcast channels; is that right?
MR. HANNAH: Objection. Form.
THE WITNESS: They may or may not be, but it's pretty clear that -- as the evidence shows, that a public bubble is what appears to be likely

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that of the broadcast channel.
BY MR. TOMASULO:
Q What factors do you look at to determine whether there's one or more broadcast channels when you're looking at something like this?
A So, for example, evidence that a bubble is like a broadcast channel is -- just as one example, on page 20 the Exhibit 2029 shows a figure with text below it saying that Destiny is a world of intersecting, not parallel lines. Most of time players are just passing through public bubbles or passing through broadcast channels. 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.
So that relates to the figure we were just talking about, which shows physics hosts such as Alice and Deborah, and it's saying that these physics hosts, which are connected to public bubbles, could leave the public bubble, and, as a result, the broadcast channel has to proceed through a method that deals with that disconnection in order to heal itself.
Q Well, it's -- in your view is it if -- if you replace one physics host with another one or

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migrate the people that were attached to a physics host to a separate physics host, is that, in your view, practicing the claim? Is that healing a disconnection?
A So --
MR. HANNAH: Objection. Form.
THE WITNESS: So in my view, I have not done the complete analysis to determine an opinion on infringement. Rather, what I've shown here is that the evidence strongly suggests that it's highly likely that the claim elements in claim six are being practiced by the PlayStation product.
BY MR. TOMASULO:
Q So we -- I had asked you to identify a single -- well, I wanted you to take a single broadcast channel and carry me through the method and show me how, in your view, you have come to the conclusion that it is highly likely that this method is practiced. So we'll do one single broadcast channel that you get to choose. So you'll show me, if you can, the broadcast channel, and then show me how the method steps are performed. Can you do that?
A Well, as I've said, you know, when you looked at page 20, you -- you see a description of

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the public bubbles that we were just talking about in the other figure. And in Exhibit 2029, it describes a method for disconnection and healing that occurs when a participant leaves a broadcast channel or a public bubble, as described by Sony.
Q So what is the broad -- so we're going to -- what is the -- what is a broadcast channel that you contend satisfies the performance of -- what we would consider the performance of claim six has been achieved or is likely to have been achieved?
A So --
Q What is a --
A So in this example the broadcast channel would be the public bubble.
Q Okay. And who are the -- so broadcast channel consists of, like all graphs, participants and edges, right?
MR. HANNAH: Objection. Form.
THE WITNESS: The broadcast channel would have nodes and links or edges between them, yes.
BY MR. TOMASULO:
Q Okay. And so we wouldn't know whether the broadcast channel is m-regular or incomplete unless we know who all of the members of the broadcast channel are, correct?

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MR. HANNAH: Objection. Form.
THE WITNESS: To be able to prove definitively that an m-regular graph is formed, one would have to perform an analysis that goes beyond what was done in this claim chart.
BY MR. TOMASULO:
Q Okay. Would you agree -- have you heard a graph being defined as a set of vertices or nodes and a set of edges? I'm sure you've heard of that, right?
A Yes.
Q Okay. And what does that mean?
MR. HANNAH: Objection. Form.
THE WITNESS: Well, that means that the graph topology is composed of nodes which are usually represented by circles and edges, which are usually represented by line segments that connect the circles together.
BY MR. TOMASULO:
Q And so when -- and to define a graph, you need to know all of the two sets or you need to know the set vertices and the set of edges? That's what defines the graph, right?
MR. HANNAH: Objection. Objection. Form.
THE WITNESS: Well, there are other

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characteristics that go into defining a graph, such as whether or not edges are two-way versus one-way, et cetera, but as a general rule, graphs are depicted as a combination of nodes and line segments between those nodes.
BY MR. TOMASULO:
Q Okay. And so you need to know all of the numbers of each set? In other words, you need to know all of the vertices and all of the edges in order to determine the topology, right?
MR. HANNAH: Objection. Form -- objection to the form of the question.
THE WITNESS: Well, as I said earlier, a graph is composed of the nodes and the edges between them. So that's what -- that's how you create the graph.
BY MR. TOMASULO:
Q Right. And so the answer to my question is, yes, you need to know those things? You can't tell --
A At a minimum, yes.
Q At a minimum.
Okay. And how you define the edge is important, right?
A What do you mean, "how you define" it?

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Q Well, an edge, when it represents something, is typically either represented by a list or a set of rules, right?
MR. HANNAH: Objection to form.
THE WITNESS: An edge is simply a link or a connection between two nodes. The way in which a edge is implemented is typically not shown in the graph.
BY MR. TOMASULO:
Q But when it's represented -- so what you're saying, though, is that the graph is representative of -- of the computer network, right?
MR. HANNAH: Objection to form.
THE WITNESS: A graph is not necessarily associated with a computer network, but it is -- it's showing an interconnection between nodes.
BY MR. TOMASULO:
Q In this instance there -- the claim isn't to a graph, is it? It's to a method performed on a computer network that, if graphed, has a certain set of properties, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Well, again, the independent claim six is really directed towards a method in which a node disconnects from a broadcast channel

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that overlays a point-to-point communications network.
BY MR. TOMASULO:
Q And the broadcast channel has to be m-regular where m is at least 3, right?
A Yes.
Q And so for us to determine whether the broadcast channel is m-regular and m is at least 3, we need to know all of the members of the broadcast channel, correct?
MR. HANNAH: Objection to form.
THE WITNESS: There would have to be at least one scenario that is analyzed in which you're able to prove that an m-regular graph where m is at least 3 has been formed; that's true.
MR. TOMASULO: I'm sorry. Could you repeat my question, please. I'd like an answer to that one.
(Record read by the reporter as follows:
"QUESTION: And so for us to determine whether the broadcast channel is m-regular and m is at least 3, we need to know all of the members of the broadcast channel, correct?")
MR. HANNAH: And what was his answer?

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(Record read by the reporter as follows:
"ANSWER: There would have to be at least one scenario that is analyzed in which you're able to prove that an m-regular graph where m is at least 3 has been formed; that's true.")
BY MR. TOMASULO:
Q Are you able to answer my question?
A Yes, I believe --
MR. HANNAH: He did answer your question.
MR. TOMASULO: You're not testifying. I put up with a lot of speaking objections today. You know the rules as well as I do.
MR. HANNAH: You ask me questions, I'm going to answer them.
MR. TOMASULO: I didn't ask you any question.
MR. HANNAH: I haven't had a single speaking objection.
BY MR. TOMASULO:
Q In order to determine whether a broadcast channel is m-regular and m is at least 3, you need to know who all of the members of the broadcast channel are, correct?
MR. HANNAH: Objection. Form of the

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question.
THE WITNESS: For the particular scenario that you're analyzing, that's correct.
BY MR. TOMASULO:
Q Okay. And you also need to know all of the edges, right?
MR. HANNAH: Objection to the form of the question.
THE WITNESS: Within the particular scenario that you're analyzing, yes.
BY MR. TOMASULO:
Q Okay. So to determine whether any specific broadcast channel meets the m-regular topology requirement where m is at least 3, we need to know who the members of the broadcast channel are and the complete set of edges that connect those members, right?
MR. HANNAH: Objection to form.
THE WITNESS: Within that broadcast channel, that's correct.
BY MR. TOMASULO:
Q Correct. Correct. So within that broadcast channel.
So what can you -- can you identify a broadcast channel that meets -- where you can

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identify all of the participants on all of the edges and show how it is m-regular or m is at least 3? Is it in your chart?
A No, it's not in the chart.
Q Okay. Can you do it sitting here today, identify just one broadcast channel where you can identify all the participants and explain why it meets that topology requirement?
A At this time, no.
Q Okay. Let's go to claim element 6B. Okay.
Do you see that?
A Yes.
Q Okay. So then you say here that -- in the second paragraph: "The Sony PlayStation product --" let's go up to the first -- you say: "The Sony PlayStation --" I'm sorry. Are you there? I don't want to -- we're on page 9.
A Yes, I'm here.
Q Okay. So you say: "The Sony PlayStation product meets the recited claim language," right? That's what you say?
A Yes.
Q But, again, you're not making an allegation of infringement, right?

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A Yes.
Q Okay. And then you say: "Because it attempts to send messages from a first computer to a second computer within m-regular connectivity meshes of players during different network game sessions and for different game session data and make sure that each player 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," right?
A Yes.
Q That's your testimony?
A Yes.
Q And then you go on and you say in the next paragraph -- you say: "The Sony PlayStation product includes functionality that attempts to send messages from a first computer to a second computer within m-regular connectivity meshes of players during different network game sessions and for different game session data and make 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," and then you have a screenshot.

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Is that right?
A Yes.
Q And, then, so Exhibit 2030 and 2031, those are your evidence for that?
A Let's see. For claim element 6B I use Exhibits 2030, 2031, 2028, 2023, 2034, 2024, 2035, 2029, 2037, 2036, and 2032.
Q Okay. But it includes 2030 and 31, which are the ones that are on this page, right?
A On this page, that's correct.
Q Okay. And you're talking about the Sony PlayStation product and the functionality that that PlayStation product has, right?
A Yes.
Q And then you've used this screenshot below to show what you contend is the Sony PlayStation functionality, right?
A That's part of the evidence that I looked at, yes.
Q And then -- but if we look at what 2030 is and what 2031 is, can you see that the -- it says here: "For use only with Xbox 360"? Do you see that?
A Yes.
Q Okay. What's Xbox 360?

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A That's a game console.
Q And who makes that?
A Microsoft.
Q So you would agree that that doesn't have anything to do with how the Sony PlayStation works, right?
A It appears from the writing that it's limited to the Microsoft Xbox 360.
Q All right. So it doesn't have anything to do with proving what you've said in that prior paragraph, anything about the Sony PlayStation product, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Well, the -- although that sentence does indicate that what is shown in the screenshot is for use only with Microsoft Xbox 360, this came from a link online describing the Destiny product.
BY MR. TOMASULO:
Q But what's the Destiny product?
A Well, it's not the Microsoft Xbox 360, so --
Q What's --
A I'm just saying that, you know, this sentence that says "For use only with Xbox 360" is

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not necessarily all the evidence that I'm pointing to.
Q Be that as it may, but you would agree that this is not any evidence at all of how the Sony PlayStation product works, right? It can't be. It has to do with Xbox.
MR. HANNAH: Objection to form.
THE WITNESS: Yeah, it does look like it's limited to Xbox 360 usage, you know, but, again, I mean, this is only one of a number of exhibits that I've given for this claim element.
BY MR. TOMASULO:
Q And another one is 2031, right?
A Yes.
MR. TOMASULO: Let's mark that.
(Exhibit 8 was marked for identification by the court reporter.)
MR. TOMASULO: This would be what exhibit number?
THE REPORTER: 8.
BY MR. TOMASULO:
Q And, again, this is an Xbox -- this is -- looks -- appears to be cover art from an Xbox 360 version of the Destiny game, right?
A Yes.

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Q Okay. So, again, that wouldn't have any evidence at all as to how the Sony PlayStation works --
MR. HANNAH: Objection. Form.
BY MR. TOMASULO:
Q -- because this is a Microsoft product?
A Well, certainly the Destiny game application can run on a variety of game console platforms and is not limited to only operating in the context of an Xbox 360.
Q Well, you would agree that Exhibit 2031 does not support the statement above, which says: "The PlayStation product includes functionality --" and so on and so forth "-- as shown in the screenshots below"? Those screenshots below do not support the statement above, correct?
MR. HANNAH: Objection to form.
THE WITNESS: Only indirectly; that's correct.
BY MR. TOMASULO:
Q How do they even support it indirectly? You said you don't know anything about the Microsoft Xbox, right?
A What these exhibits are showing is the Destiny product, and the Destiny product runs on

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multiple game consoles, not just the Xbox 360 console.
Q Do you know if it runs the same on each console?
A The Destiny product is an online multiplayer game regardless of which game console it's running on.
Q So it would -- as far as these claims are concerned, the Xbox functionality is, in your view, going to be the same as the Sony functionality?
A With respect to the features described in the '147 patent, they both are online gaming platforms that support applications -- or game applications such as Destiny to perform the functions described in claim six.
Q Do you think it's reasonable to use information about Microsoft-compatible games to infer how the Sony PlayStation works? Do you think that's reasonable?
A Not in isolation, which is why I included other evidence to also support this nexus view.
Q Did you choose these exhibits knowing that they were Microsoft Xbox exhibits --
A I chose --
Q -- or was this a mistake?

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A I chose these exhibits in combination with the other exhibits for this claim element to show that there's a highly likelihood that the PlayStation product, which also supports the Destiny game, is likely to perform in the same manner.
Q But you don't mention that in your charts? You don't say: "I'm using a Microsoft-compatible software to show how the PlayStation works"? I mean, you don't -- you don't explain that, right?
MR. HANNAH: Objection to form.
THE WITNESS: That's not described in the summary chart, no; that's correct.
BY MR. TOMASULO:
Q Okay. In any of the Destiny materials that you've relied on, did you determine whether the game was operating the same in the context of the Sony PlayStation or the Microsoft Xbox? Did you determine that?
A I did not determine what differences there are between the operation of a game application on the two different platforms.
Q But when you read -- you know, you have some exhibit from Destiny or you watch a YouTube video, were you watching it with an eye towards determining whether it was actually talking about

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the Sony PlayStation or whether it could have been talking about the Microsoft Xbox or the Wii or a PC version?
A Again, as I've said, there are a number of exhibits that I've cited in reference to this particular claim element and not just these first two because, through the preponderance of the evidence, I'm showing that it's highly likely that the PlayStation products are performing these functions, and it was for that reason that this art -- this -- these exhibits are showing Destiny running on the Xbox 360 that I did not stop with these two exhibits but included additional exhibits as well as part of showing the preponderance of evidence.
Q Okay. Let's go to Exhibit 2033. Do you see that? That's on page 12.
What does Exhibit 2033 refer to?
A This is a YouTube video that can be found at this link.
Q And did you make this screenshot?
A This screenshot was itself captured and shown to me by the attorneys.
Q Okay. So not your screenshot.
Did you watch the video?

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A Yes, at that link, yes.
Q Okay. And then who -- who made the video or what -- you know, what is the reliability of the video?
MR. HANNAH: Objection to form.
THE WITNESS: What do you mean by "reliability"?
BY MR. TOMASULO:
Q Well, what is the video?
A It's showing a scene in which multiple participants are communicating over the Internet.
Q And what game is this?
A Within the context of a broadcast channel.
Q And what game is this that's being shown?
A I'm trying to remember. I don't remember the exact name of this particular game.
Q So it's a screenshot you didn't make from a video you didn't make for a game you can't remember?
MR. HANNAH: Objection. Argumentative.
THE WITNESS: It's just one in a series of evidences presented in this -- for this claim element that's showing that it's highly likely that the Sony product is -- includes the functionality of the claim limitation.

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BY MR. TOMASULO:
Q How does that screenshot show that there's attempting to send a message from a first computer to the second computer?
A Well, you can see in this screenshot it's, for example, showing one participant waving to another participant in two different instances.
Q Okay. So is -- is it -- if this was a game that was pure client server and the first computer sent the message to the server and then the server sent the message to the second computer, would that meet the claim limitation, in your view?
MR. HANNAH: Objection. Form.
THE WITNESS: It depends.
BY MR. TOMASULO:
Q Well, don't -- don't the -- isn't a requirement that the first computer and the second computer be connected to the broadcast channel?
A Yes.
Q Okay. So can the second computer, then, in this instance be a server?
A It's possible.
Q Okay. So the second computer could be a server, and that would make the server a member of the broadcast channel?

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A It's possible.
Q Okay. So if the server was a member of the broadcast channel, could it ever be m-regular with m greater than 3?
A It's possible.
Q How would -- how would that happen?
A It depends on the context, but certainly possible for any node in a broadcast channel to be considered a server.
Q Okay. So -- but if it -- if -- let's just say -- if there was just a single server, then would it be possible, if the server was a member of the broadcast channel, for the -- for the broadcast channel to be m-regular with m greater than 3?
A It's certainly possible.
MR. HANNAH: Object to form.
BY MR. TOMASULO:
Q If it's -- if all of the connections are only client server so that the players are connected directly to the server and not to each other, would it be possible for it to be m-regular with m greater than 3?
MR. HANNAH: Objection to form.
THE WITNESS: For example, if you had a plurality of servers, then you can have participants

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connecting to server nodes in an m-regular fashion and, as such, you would still maintain your m-regular graph.
BY MR. TOMASULO:
Q Okay. So let's assume, though, that there's just one server managing the game play data and so that all of these players are connected to a single server -- one and only server -- and they're not connected to each other. The only send and receive data from that server. In that instance, if the server was a member of the broadcast channel, then the broadcast channel is not m-regular with m greater than 3, right?
MR. HANNAH: Objection to form.
THE WITNESS: So what you're saying is if you hypothetically create a network that's not an m-regular graph, is it, therefore, not an m-regular graph, and I would say yes.
BY MR. TOMASULO:
Q Okay. So in this instance how many players are there in this screenshot 2033? One, two, three, four, five, six -- at least six? Is that about right?
A Seven.
Q Okay. So if all seven of those players

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for game play data have just one connection to the server and no connections to each other for game play data, then that -- that broadcast channel is not m-regular with m being at least 3, right?
MR. HANNAH: Objection. Form.
BY MR. TOMASULO:
Q Because each of the --
A So I understand your question, you're saying if you were to hypothetically create a network that's not an m-regular graph network, it is, therefore -- isn't it, therefore, not an m-regular graph? And I would say, by definition, it's not if you've created a graph that's not an m-regular network.
Q Well --
A By definition it's not an m-regular graph.
Q Well, I didn't create a graph. I was just hypothesizing about a network.
So if the network is a client -- you're familiar with client server network, right?
A Yes.
Q Okay. And in a client server network each of the clients is connected to the server but not to each other, right?
A Yes.

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Q Okay. And so in that instance if there are more -- if there are several clients and one server, then -- and if the server is a member of the broadcast channel, then that broadcast channel is not m-regular, right?
MR. HANNAH: Objection. Form.
THE WITNESS: It may not be true in all cases.
BY MR. TOMASULO:
Q Okay. In what case could it possibly be m-regular if the server is a member -- if there's one server and eight clients -- or seven clients -- if there's one server and seven clients and each of the clients is connected to the server and not to each other, in what instance can it be m-regular?
A It depends on the number of total nodes in the broadcast channel.
Q Well, in this instance we've identified eight.
A So what you're saying is you want to create a broadcast channel that's not m-regular, and the question is is it not m-regular?
Q No. That's not my question. My question is -- is if there's seven players and they're all connected to a single server and not to each other,

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I just want you to acknowledge that that's not m-regular.
MR. HANNAH: Objection. Form.
THE WITNESS: It really depends.
BY MR. TOMASULO:
Q Well, I've given you all of the facts. What -- is there some other fact that you are unclear on in my hypothetical?
A So in your hypothetical what you're describing is the interconnections of a point-to-point communications network that has eight nodes in it, and overlaid on top of that point-to-point communications network would be a broadcast channel, and since the broadcast channel is an overlay on top of the point-to-point communications network, then a direct link in the broadcast channel does not necessarily correspond to a single link in the point-to-point communications network.
Q What is your evidence --
MR. HANNAH: Counsel, we've been going another hour and a half.
MR. TOMASULO: Well, do you want to take a break? That's fine. How much time have we -- have we done on the record?

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THE VIDEOGRAPHER: Five hours and fifteen minutes.
MR. TOMASULO: Okay.
THE VIDEOGRAPHER: Going off record at 4:16 p.m.
(Recess.)
THE VIDEOGRAPHER: Back on record at p.m.
BY MR. TOMASULO:
Q Can we go to page 17 of your chart, which is Exhibit -- what number is that for the record?
MR. TOMASULO: 8.
BY MR. TOMASULO:
Q 8. Exhibit 8, which is Exhibit 2016 as marked.
Are you there?
A Yes.
Q Okay. So on page 17. And then claim element 6C says that "When the attempt to send the message is unsuccessful --" and that's referring to the message that's referred to element 6B, right?
A Yes.
Q "Broadcasting from the first computer a port search message indicating that the first computer needs a connection."

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Do you see that element?
A Yes.
Q And then you have said that the Sony PlayStation product meets the recited claim language because when the attempt to send the message is unsuccessful, that includes functionality to broadcast from the first computer a port search message indicating the first computer needs a connection port, right? That's your testimony?
A Yes.
Q And then you go on to say that "It includes functionality that 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 server to find a connection port to another player that can be used to maintain an m-regular graph in the game session or match or to create an optimized connectivity mesh of players and keep games running whenever PlayStation consoles disconnect from the game 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."

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That's your testimony?
A Yes.
Q Okay. What is the first computer that broadcasts the port search message?
A The first computer would be any of the remaining computers in the broadcast channel which attempts to send a message across the broadcast channel.
Q So can -- can you identify a specific -- is it going to be a player? a PlayStation? What -- what specifically are you referring to in this when you say "the first computer"?
A The first computer would be, in the context of this chart, the Sony PlayStation product that had connected to the broadcast channel.
Q Okay. And -- and does the port selection message -- that goes out on the broadcast channel or it goes out wherever?
A The --
MR. HANNAH: Objection. Form.
THE WITNESS: The connection port search message is broadcast on the broadcast channel.
BY MR. TOMASULO:
Q Okay. And that's what the claim requires?
A I haven't looked into the full scope of

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claim six with respect to whether or not a connection port search message can be transmitted outside of the broadcast channel and still meet the claim limitation, but certainly if the connection port search message is transmitted within the broadcast channel, then that would be part of -- that would fall within the scope of claim 6C.

Q And is that what you're contending is happening here, that the broadcast message is being sent on the broadcast -- I'm sorry -- that the connection port search message is being sent on the broadcast channel? Is that what you're contending is happening here in the page 17?

A From the evidence that I've cited, it appears that connection port search messages are being sent within the context of the broadcast channel that is overlaying the underlying Internet and not sent across the entire Internet to any node on the Internet.

Q Okay. And then when you're talking about host migration, how is it that host migration if -- this claim is directed to the removal of a node, right, and healing a disconnection?

A Yes, the healing of the network after a node has been disconnected in an unplanned fashion.

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Q Okay. And so what -- what is the node that you're saying is removed here? A host?

A The -- there's a physics host that is disconnected from the broadcast channel, and when that happens, a new physics host has to be determined. So the old physics host is what was disconnected.

Q And then they join up with a new physics host, right?

A A new physics host is elected for the broadcast channel, yes.

Q And is that new physics host already a member of the broadcast channel or can it be someone who is not a member of the broadcast channel?

A During this transitory state, I haven't reached an opinion as to whether or not the physics host was -- the new physics host that was elected was already part of the broadcast channel or became connected to the broadcast channel during that transitory state.

Q So is there -- is it -- the claim requires removal of a node, right, at a minimum?

A Yes.

Q Okay. So if you remove a host and replace it with a new host, in your view, does that satisfy

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the claim?

A Well, when you say "satisfy the claim," to me it sounds like you're saying does that prove infringement of the claim. And for that to happen, every claim element needs to be -- needs to be satisfied and not just a node was disconnected and a node was added, but there's a -- the claim elements are very specific about the method for disconnection and healing that need to take place in order to prove infringement.

Q Okay. Let's suppose that no node is removed. Does that mean that the claim hasn't been performed?

MR. HANNAH: Objection. Form.

THE WITNESS: Well, I think, you know, what the claim requires in claim element 6A is for a first computer to be disconnected.

BY MR. TOMASULO:

Q So you don't agree that this is a process for actually removing a node, claim six?

A As I just said, claim element 6A states that the method includes the disconnection of a first computer.

Q Okay. And do you agree that it is this -- this claim six is directed to removing the node from

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the broadcast channel?

A Claim six is directed towards an entire method, which includes, as one of its elements, the disconnection of a first computer, but there are many other components that make up claim six besides simply the disconnection of a first computer.

Q Do you -- is it -- do you -- so is this a correct statement or not: The -- that claim six is a method for removing a node or participant from an existing network?

MR. HANNAH: Objection to form.

THE WITNESS: Well, as I said earlier, claim -- there are a number of elements in claim six and a number of things required to satisfy claim six. The disconnection of a first computer is only one of the things that is required in order to meet claim six.

BY MR. TOMASULO:

Q Okay. So in -- when you're talking about host migration, what -- what is the port connection message that you contend is broadcasting?

A The connection port configuration message -- no, the connection port search message is necessarily part of the process of migrating to a new physics host.

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Q So where is the evidence that a first computer -- well, when you say "broadcast," it means that it goes to everybody on the channel, right?
MR. HANNAH: Objection to form.
THE WITNESS: A broadcast channel message is called a broadcast because that message is typically distributed throughout all the nodes in the network, but it is not necessarily required that every single node must receive the message for it to be a broadcast message.
BY MR. TOMASULO:
Q So where -- what do you contend satisfies the requirement that the first computer broadcasts a port search message indicating that the first computer needs a connection? Where is -- where is it shown in your chart that such a message is broadcast by a first computer?
A So on page 18 it says: "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," which indicates that any of the remaining nodes that are connected to the broadcast channel can potentially become the new physics host. For that to happen, then a

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connection port search message, you know, is broadcast on the broadcast channel.
Q So where is your evidence that the connection ports -- so if -- is the physics host -- what does that mean to be a physics host? Does that mean that they are acting as a server?
A The full extent of the physics host functionality is not known at this time but could be ascertained through confidential information that I do not have access to.
Q So -- but what do you interpret it to be? Is the physics host -- what does it mean to be a host? What are your interpretation of these -- of the evidence that you have now? What did you think it meant?
A So the physics host is required in order to maintain a broadcast channel, and, as is described in the charts, a physics host keeps the simulation state synchronized across all of the participants on a broadcast channel. So without a physics host, there is no synchronization of the game across all of the participants on a particular broadcast channel.
Q Isn't a physics host a separate process that's being run so that you are -- if you have --

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if you're the physics host, then you're actually running two processes. One is that you are the host, and the other is that you are a player, right?
A But, again, as we saw --
MR. HANNAH: Form.
THE WITNESS: -- at a high level, a physics host is one box called physics host. Within that box there could be a plurality of processes, but at the abstraction of the evidence, a physics host is a single box.
BY MR. TOMASULO:
Q And a player is a single box? They're different boxes, right?
A Not necessarily. They could be coincident on the same hardware platform.
Q But they would be different processes on the same hardware platform?
A Depending on implementation.
Q And so when you add a new physics host, you've added a new process or a new member to the broadcast channel, right?
A Not necessarily.
Q Okay. What -- under what circumstances would you say that that is not the case?
A One could add a new physics host in a

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variety of ways. One could do it by adding a new node to the broadcast channel that has a new physics host in it, or one could do it by starting a process on an existing node that is a player and simply adding a new process that's a physics host process, and there are potentially other ways that physics hosts can be introduced into the broadcast channel.
Q So your -- is it your contention that when a host migration occurs at the -- that there is a message that constitutes or metes the limitation of a port -- a connection port search message that's broadcast to the existing members of that broadcast channel?
A From what the -- what appears in the evidence, the connection port search message of the Sony PlayStation products is broadcast within the scope of the broadcast channel since the underlying point-to-point communications network is the entire Internet, and it does not appear from this evidence that the Sony PlayStation products are sending messages to every node across the entire Internet.
Q What is the significance of -- on page 21 -- the bubble swap figure? Once you get there, I have a different question. Are you on page 21?
A Yes.

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Q Okay. So you say: "The Sony PlayStation product includes functionality to create m-regular topologies of players."
Do you see that?
A Yes.
Q And you say: "When setting up logical and physical network topologies."
Do you see that?
A Yes.
Q And what's a physical network topology? What do you mean by that? Did you write those words?
A Yes, but I'm trying to make sure that I give an accurate explanation of the sentence.
A logical topology within the context of the '147 patent would be a topology that relates to the logical broadcast channel, whereas a physical network topology would relate to topologies that exist for the point-to-point communications network.
Q Okay. So what is -- what does it mean to set up a physical topology to handle activity in fail-over states?
A That would be to establish links in the point-to-point communications network for communication.

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Q And that's at the lower levels of the protocol stack -- of the OSI layer?
A The point --
MR. HANNAH: Objection. Form.
THE WITNESS: The point-to-point communications network underlies the logical broadcast channel.
BY MR. TOMASULO:
Q Okay. And so what level is the physical network topology that you're referring to here?
A So the physical network topology would be the topology that's associated with links in the point-to-point communications network.
Q Isn't the point-to-point communication network still a logical connection, a TCP/IP connection? Isn't that a logical connection?
MR. HANNAH: Objection to form.
THE WITNESS: In the context of the '147 patent, there's a distinction between a logical broadcast channel and a point-to-point communications network, but they're not one and the same.
BY MR. TOMASULO:
Q I understand, but what -- a TCP/IP connection is still a logical construct, isn't it?

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MR. HANNAH: Objection. Form.
THE WITNESS: Within the context of the '147 patent and what the specification teaches, a TCP/IP connection is a link in a network topology.
BY MR. TOMASULO:
Q Okay. But a T -- a TCP/IP connection is not a physical connection, right? That's what I'm trying to get at.
MR. HANNAH: Objection to form.
THE WITNESS: A TCP/IP connection is established as part of a point-to-point communications network.
BY MR. TOMASULO:
Q But it's not a physical connection, right? It's not like a plug?
MR. HANNAH: Objection to form.
BY MR. TOMASULO:
Q It's not wires?
A But, again, as part of what the '147 patent describes it to be, it is saying that TCP/IP links are part of the network topology of the point-to-point system.
Q I'm sorry. But my -- my question is pretty simple.
A TCP/IP connection is not a physical

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connection, is it?
MR. HANNAH: Objection to form.
THE WITNESS: Again, we're talking about the '147 patent.
BY MR. TOMASULO:
Q We're talking about TCP/IP connection. Is it or is it not a physical connection?
A Well, if we want to have a separate discussion outside of the context of the '147 patent, then the TCP/IP connection that is formed forms a connection between two computers over an arbitrary network, and underneath the TCP/IP layer you would have additional OSI stack layers leading down to what's called the physical layer, and it's at the physical layer where you would have either wires or wireless communication taking place.
Q Okay. And so when you say that "The Sony PlayStation product includes functionality to create m-regular topologies of players when setting up logical and physical network topologies," what do you mean by physical network topologies?
A What I'm describing there is that the point-to-point communications network has physical -- has a physical topology to it, that it's a network -- point-to-point communications network

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such as, for example, the Internet. The Internet is not just some logical, ethereal thing. The Internet is made up of -- of real hardware that is interconnected by real cables and real wireless media, and at -- that are -- that are physical and tangible in nature.

So a point-to-point communications network has physical -- a physical topology to it. So that's why I use the word "physical network topologies," to emphasize that this is describing a topology that's actually physical as opposed to a logical one which overlays physical connections.

Q Does the Sony PlayStation product set up a physical network topology?

A The Sony PlayStation product includes the functionality that's used when one is setting up logical and physical network topologies.

Q How does the Sony PlayStation product include functionality that one uses to set up a physical network topology?

A So, for example, the matchmaker technology is functionality that is used to establish these logical and physical network topologies. In -- in addition to that, the -- the host migration process is another functionality that's used to set up

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logical and physical network topologies, and potentially other functions that -- that I haven't mentioned are also part of that whole process.

Q What's a physical network topology that Sony sets up?

A So, for example, when a PlayStation product communicates to the Internet, it does so using some form of physical media, whether it's a wired physical media or a wireless media, but there needs to be a physical media over which the PlayStation product connects to the point-to-point communications network of the Internet.

Q So what does the physical network topology have to do with whether or not this claim limitation is met?

A Well, because you have to have a -- a topology of the point-to-point communications network in order to overlay a broadcast channel that's an m-regular graph.

Q Now, I thought that the patent, in your view, was directed at the application layer, that it was the connections amongst applications that were edges? I thought that was your testimony?

A So it was my testimony from earlier today that the broadcast channel is an overlay channel on

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top of the point-to-point communications network and that it is used by applications for forming logical connections over this underlying point-to-point communications network.

Q So do you need to know anything about the physical layer to determine infringement?

MR. HANNAH: Objection. Form.

BY MR. TOMASULO:

Q Or the physical topology as -- physical network topology?

Does the physical network topology have anything to do with whether the Sony PlayStation meets this element 6C of the claim?

A Whether or not a physical network topology is required by the claim element, I -- I have not reached an opinion on. What I'm saying here is I'm describing not the claim element or the '147 patent. What I'm describing is the Sony PlayStation product. And what I'm saying is that in the process of the PlayStation product establishing physical -- a physical network topology and a logical topology on top of such physical network topology, that it is meeting the nexus requirement for claim element 6C.

Q If you go to page 1, you -- let me know when you're there.

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A I'm there.

Q You say: "The functionality creates m-regular topologies of players when setting up logical and physical network topologies in order to do the following."

Are you saying that the functionality creates an m-regular physical topology?

A What I'm saying here is that the Sony PlayStation product appears to be establishing m-regular topologies that are a combination of logical and physical network topologies.

Q So going back to page 21, this is -- what's going on in this? You have -- you say here at the top: "To handle activity in fail-over states when player are -- players are no longer connected or leave via host migration to a new physics host."

What is being represented here in this Exhibit 2029?

A So in this exhibit -- this exhibit is showing that there is a transient state to the broadcast channel within which host migration occurs. So before the fail-over begins, the network was an m-regular -- had an m-regular topology and that during host migration there's a period of time where the network is being reconfigured, and then

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after host migration has completed its functions, then what we're left with is a -- again, an m-regular topology.
Q Okay. And there's a new host; is that right?
A With a new physics host, yes.
Q Okay. And so how does that affect the removal of a node from a network if they just have a change from one physics host to another? What does that do to affect the removal of a node -- or does it?
A Well, a physics host is a node in the network. So when a new physics host is chosen, you're necessarily disconnecting the old physics host so that messages are not sent to the old physics host in an inadvertent or incorrect fashion.
Q So host migration is not something new, right? The patent didn't invent host migration; would you agree with that?
MR. HANNAH: Objection to form.
THE WITNESS: The patent doesn't use the words "host migration." However, I -- I haven't done an infringement analysis to show whether or not the functionality of host migration is specifically claimed in the asserted claims.

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BY MR. TOMASULO:
Q So you're not saying that this actually meets the limitations of the claim? You're just saying it's possible? It's likely? Something like that? What's the point of this?
A What I'm showing in this claim chart is that there is a nexus between the functionality in the Sony PlayStation product and the '147 patent inventions.
Q Is there a way to do host migration without infringing this claim six of the '147 patent?
A I don't --
MR. HANNAH: Objection. Form.
THE WITNESS: I don't know.
BY MR. TOMASULO:
Q But it's not your testimony that all host migration would meet the limitations of the '147 patent, is it?
MR. HANNAH: Objection. Form.
THE WITNESS: I have not looked at the confidential information regarding the specific functionality of the host migration functionality in the Sony PlayStation product, but if given a chance to do so, then I would be able to render an opinion

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specifically as to whether or not the host migration functionality infringes any claim element in the asserted claims.
BY MR. TOMASULO:
Q But right now you're just not able to do that?
A Right now I can't establish that there is a nexus between what's in host migration and the '147 patent based upon evidence in this chart and the fact that a license was taken on the '147 patent at a time when a license didn't necessarily have to be taken.
Q Let's go to claim element 6D. But before we do 6D, I have a question.
What is UDP?
A UDP stands for the User Datagram Protocol.
Q Okay. And in User Datagram Protocol, or UDP, when one computer sends another computer a UDP message, there's no acknowledgment returned, right?
A The UDP protocol itself does not require that an acknowledgment be sent to a UDP instance; that's correct.
Q Okay. So if -- in UDP, when the first computer tries to send a message to a second computer, it doesn't know if the second computer got

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it, right?
MR. HANNAH: Objection. Form.
THE WITNESS: The UDP entity itself does not know whether or not the message arrived.
BY MR. TOMASULO:
Q Right. In TCP/IP there is some verification of arrival process, right?
A So for the TCP protocol, the TCP entity waits for an acknowledgment message to be received acknowledging the receipt of the transmitted packet.
Q So in the instance if a -- if the communications are being sent by UDP, the sender won't know if its message got to the second computer? The first computer sends a message to the second computer. It won't know if that message was unsuccessful, right?
MR. HANNAH: Objection. Form.
THE WITNESS: You can't say one way or the other based purely on -- on that information.
BY MR. TOMASULO:
Q But UDP -- if -- UDP does not include a method for the sender to know if the -- if the second computer received the message from the first computer? UDP just doesn't have that as part of its protocol, right?

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A Right.
MR. HANNAH: Objection. Form.
THE WITNESS: Within the context of UDP, there's -- there's no ability to communicate an acknowledgment; that's correct.
BY MR. TOMASULO:
Q Okay. And if there's a UDP -- let's say there's a game where there's -- let's say, game data is being sent by UDP and voice data is being sent by TCP/IP. Would that -- would those be separate broadcast channels, in your view?
MR. HANNAH: Objection to form.
THE WITNESS: Maybe yes; maybe no.
BY MR. TOMASULO:
Q Okay. So game data and voice data could be on the same broadcast channel even if they're sent by different protocols?
A Possibly.
Q And so what would you look at to make the determination in such a scenario -- let's assume a very simple scenario where there is a number of players that are communicating voice data by TCP/IP and game data by UDP. So assume just that.
What would you look at to determine whether that was one, two, or some other number of

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broadcast channels? How would you determine that?
MR. HANNAH: Objection. Form.
THE WITNESS: Well, first, I would have to go back and review the '147 patent specification to see what limitations may be described there with respect to the transmission of different message types using different protocols as to whether or not they could be coincident on the same broadcast channel or if they necessarily must be transmitted on separate broadcast channels, and then I would look to the -- the evidence in the accused products to determine exactly how these different message types are actually transmitted.
BY MR. TOMASULO:
Q And then what would that tell you? How would that get you to a conclusion about whether something was or was not a broadcasted channel?
MR. HANNAH: Objection. Form. Outside the scope.
THE WITNESS: So, again, once -- so I've looked into this question of the full scope of the broadcast channel with respect to whether or not message -- messages formed with different protocols can coexist within a given broadcast channel, knowing whether or not that's possible according to

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the '147 patent would inform how many such broadcast channels are present in the accused products.
BY MR. TOMASULO:
Q What if there's a red team and a blue team and the red team can do its -- do a voice chat amongst the red team or it can do a voice chat amongst everybody? Would those be two separate broadcast channels, one for everybody and one for just the red team? Are those the same broadcast channel?
MR. HANNAH: Objection. Form. Outside the scope.
THE WITNESS: I would have to look in detail at the -- at the products to understand how they're performing their functions to be able to the answer that question.
BY MR. TOMASULO:
Q What would you have to look at?
A I would have to look at confidential information about the products that would be included in technical documents. It would be included in deposition testimony of engineers at the company and potentially even looking at source code.
Q And what -- what about testing? You could test for it, right?

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MR. HANNAH: Objection. Form.
THE WITNESS: Depending on the implementation, it may or may not be possible to accurately test for that condition.
BY MR. TOMASULO:
Q So 6D -- go to page 28. You say: "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 the manner as to maintain an m-regular graph."
Do you see that?
A Yes, yes.
Q And it's your opinion that the Sony PlayStation product meets the requirements of claim D because it includes functionality to do that? Is that your testimony?
A Yes.
Q But you're not saying that it -- that the Sony PlayStation product actually performed this step? You never observed that it was actually performed? You're just saying it has this function, right?
MR. HANNAH: Objection. Form.

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THE WITNESS: Yeah. What I'm saying is that it appears that the -- the functionality of the product appears to perform what's called for in claim 6D.
BY MR. TOMASULO:
Q And so you're saying to have -- it includes functionality that a third computer not already connected to the first computer respond to the connection port search message in a manner to maintain the m-regular graph, right?
A Yes.
Q So what's the third computer that you rely on here in -- in your analysis of element 6D? What is -- specifically, what is the third computer?
A That would be the new -- for example, in one of the scenarios that' -- that's disclosed in the evidence, the third computer would be the new physics host.
Q And it doesn't matter whether that physics host was already a member of the broadcast channel or not, in your view?
A I haven't looked at this claim to determine whether or not the new third -- the third computer had to have been part of the broadcast channel prior to the transmission of the connection

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port search message.
Q Now, are you able to show me what the configuration that you are relying on looks like after the completion of claim element 6D? Is that in your chart or does your chart show a -- a final product where the graph has been maintained as m-regular?
MR. HANNAH: Objection to form.
THE WITNESS: Well, so as I've said, the m-regular graph topology is the optimized topology for the connectivity mesh of players. So after the connection port search message has been sent and a new physics host has been selected, then the Sony PlayStation products would attempt to achieve that optimum state again by again creating an m-regular graph that was there prior to the disconnection of the physics host.
BY MR. TOMASULO:
Q Your chart doesn't actually show a picture of an m-regular graph at the end of this, though, right? None of the elements in 6D actually show a picture of an m-regular graph, right, let alone an m-regular graph where m is at least 3?
MR. HANNAH: Objection to form.
THE WITNESS: The picture of the m-regular

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graph, although it does not appear in the claim chart, certainly the m-regular graph is described at length in the '147 patent, which was licensed.
BY MR. TOMASULO:
Q Right. So the patent discloses what it means to perform the claim, but your chart does not include a depiction of what you contend is the final product that would meet the m-regular limitation after the performance of element 6D, right? It doesn't show that?
MR. HANNAH: Objection. Form.
THE WITNESS: Well, as I said, even though the chart does not have a figure which expressly shows an m-regular graph implementation for the soft- -- the Sony PlayStation products, my opinion about there being a nexus is based on the combination of the evidence disclosed in this chart and the fact that a license to an m-regular graph patent, namely the '147 patent, was taken in addition to the development of the functionality described in this chart.
BY MR. TOMASULO:
Q Okay. So let's just look -- page -- page 29 you have the three boxes, right: Physics host Alice, physics client Bob, physics client Charley,

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right?
A Yes.
Q And that is not an m-regular graph where m is at least 3, right?
MR. HANNAH: Objection to form.
THE WITNESS: What that is showing is three players who are connected over a point-to-point communications network in a public bubble. The logical broadcast channel that overlays that point-to-point communications network is not shown.
BY MR. TOMASULO:
Q Okay. So this does not show an m-regular graph, let alone an m-regular graph where m is at least 3, right? It just doesn't?
A It's showing the point-to-point communications network between those three players without showing the overlaid logical broadcast channel.
Q Okay. So it doesn't show it, correct?
MR. HANNAH: Objection. Form.
THE WITNESS: This figure allows for any logical broadcast channel that you want to be overlaid on top of the shown point-to-point communications network.

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BY MR. TOMASULO:
Q Okay. And then going on to the next page, page 30, this does not depict an m-regular broadcast channel either, does it?
MR. HANNAH: Objection to form.
THE WITNESS: So, again, this figure is showing the presence of a point-to-point communications network which allows for the overlaying of a logical broadcast channel that can be an m-regular graph.
BY MR. TOMASULO:
Q And you don't show the logical overlay that is an m-regular graph? It's just not here in your chart, right?
MR. HANNAH: Objection. Form.
THE WITNESS: I have not shown an m-regular graph in this figure.
BY MR. TOMASULO:
Q And the same is true for page 31 and 32 as well, right? You don't -- you don't show an m-regular logical overlay or an m-regular broadcast channel or any m regularity at all, right?
MR. HANNAH: Objection to form.
THE WITNESS: So what I -- what I show is a point-to-point communications network over which

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can be overlaid an m-regular graph such as is described in the '147 patent.
BY MR. TOMASULO:
Q Okay. But you don't show an m -- an m-regular broadcast channel in this chart, right, or on page 32? You just don't show that, right?
MR. HANNAH: Objection. Form.
THE WITNESS: Well, again, what I'm showing is the required point-to-point communications network that's required by the '147 patent so that a logical broadcast channel can be overlaid.
BY MR. TOMASULO:
Q So since you haven't shown the logical overlay and you haven't shown the logical broadcast channel that's m-regular in the chart, are you able to -- to do it right now -- to draw it on top of this and show us the logical overlay that would be m-regular and where m would be at least 3? Are you able to do that --
MR. HANNAH: Objection. Form.
BY MR. TOMASULO:
Q -- since you haven't shown it?
A I don't think I have sufficient time to do a proper infringement analysis based upon this

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figure.
Q Okay. So you can't do -- and you have these charts in here, but you can't draw the m-regular logical overlay that you contend meets the claim limitation, right? I just want to be very clear that you can't do it, sitting here.
MR. HANNAH: Objection. Form.
THE WITNESS: In order to prove the presence of an m-regular graph, you know, I would need access to confidential information regarding technical documents and access to engineers and potentially source code to be able to determine definitively if an m-regular graph is present in the Sony PlayStation products.
BY MR. TOMASULO:
Q When you're saying "m-regular graph," you mean a broadcast channel that is m-regular and m is at least 3, right? Not a graph, but a broadcast channel, right?
MR. HANNAH: Objection. Form.
THE WITNESS: It would be a logical broadcast channel that is an m-regular graph where m is at least 3 as an overlay to the underlying point-to-point communications network.
//

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BY MR. TOMASULO:
Q And you need that information to do that? That's your testimony?
MR. HANNAH: Objection. Form.
THE WITNESS: To be able to prove definitively whether or not the products infringe the asserted claims, that's true.
BY MR. TOMASULO:
Q Okay. And -- but to even draw it on here -- you can't even do that without that information? That's your testimony? Just to draw the logical broadcast channel and show that it's m-regular where m is at least 3, you can't do that now if I give you the pen?
MR. HANNAH: Objection. Form.
THE WITNESS: I can draw hypothetical things on a figure, but for me to reach an opinion on infringement, I would require access to the confidential information I stated earlier.
MR. TOMASULO: Okay. Can we take five or ten minutes, just kind of see where we are? Maybe we don't need to take much more time. I'm not sure.
MR. HANNAH: Okay.
THE VIDEOGRAPHER: Going off record at 5:29 p.m.

(Recess.)
THE VIDEOGRAPHER: Back on record at p.m.
MR. TOMASULO: No further questions.
MR. HANNAH: We don't have any questions for -- further questions for Dr. Bims at this time, but we will review and sign the transcript.
THE VIDEOGRAPHER: Okay. We are off record at 5:40 p.m., and this concludes today's testimony given by Dr. Harry Bims. Media will be retained by Veritext Legal Solutions. Thank you.
(TIME NOTED: 5:40 P.M.)

ACKNOWLEDGMENT OF DEPONENT

I, Harry Bims, Ph.D., do hereby certify that I have read the foregoing transcript of my testimony, and further certify that it is a true and accurate record of my testimony (with the exception of the corrections listed below):

Page	Line	Correction	

Signed under the pains and penalties of perjury this _____ day of _____, 20___.

_____

I, the undersigned, a Certified Shorthand Reporter of the State of California, do hereby certify:
That the foregoing proceedings were taken before me at the time and place herein set forth; that any witnesses in the foregoing proceedings, prior to testifying, were administered an oath; that a record of the proceedings was made by me using machine shorthand which was thereafter transcribed under my direction; that the foregoing is a true record of the testimony given.
Further, that if the foregoing pertains to the original transcript of a deposition in a Federal Case, before completion of the proceedings, review of the transcript [ ] was [ ] was not requested.
I further certify that I am neither financially interested in the action nor a relative or employee of any attorney or any party to this action.
IN WITNESS WHEREOF, I have this date subscribed my name.
Dated: 2/10/17

Catherine A. Ryan, RMR, CRR
CSR No. 8239

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
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

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.

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.

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

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

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

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:

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.

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.

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:

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

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

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

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.** September 2003.

Bims, Harry. "Securing Enterprise WLANs". White Paper. [Online] Available. 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

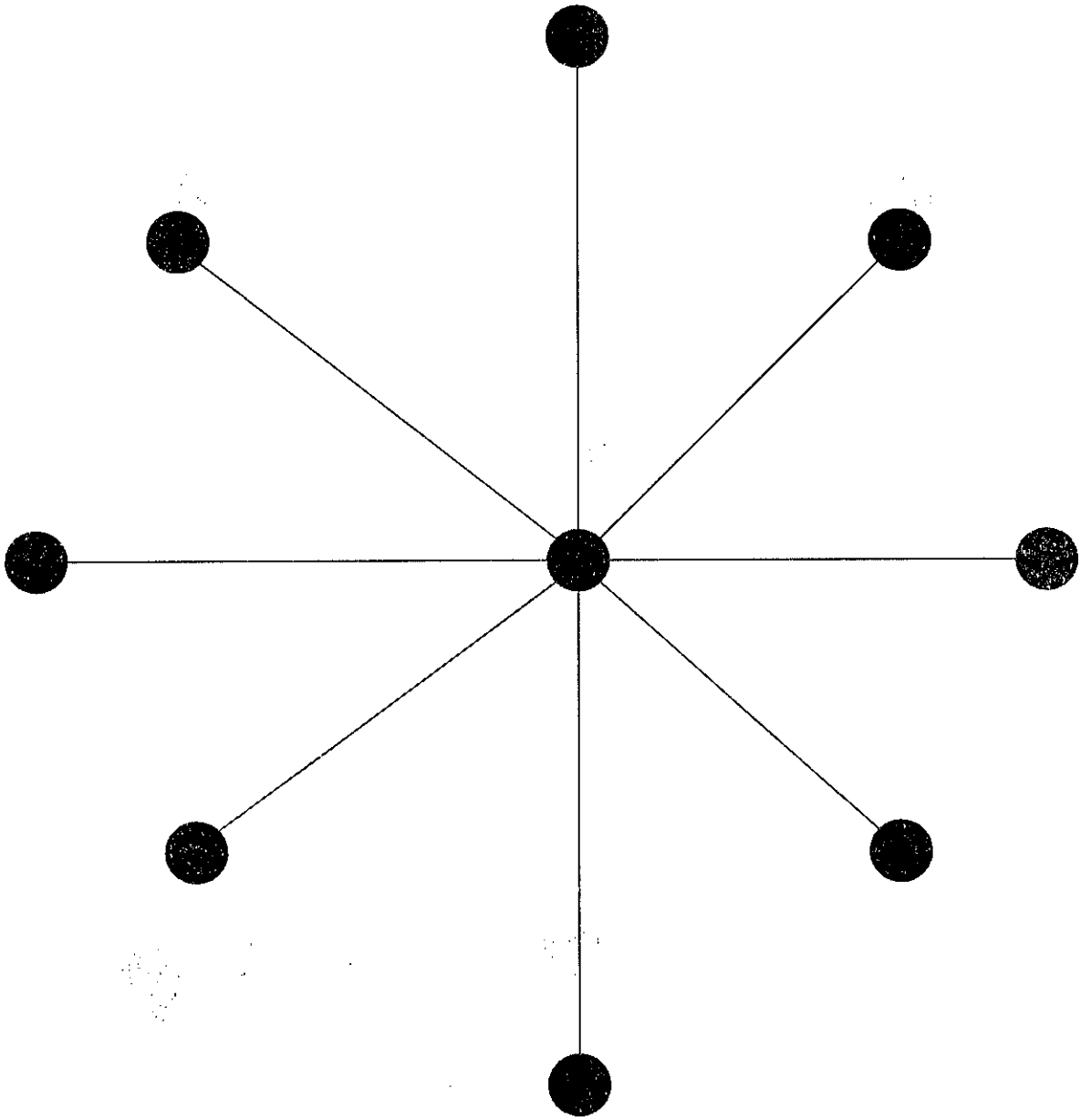

EXHIBIT
2
Bims
2/7/2017 C.A.R.

EXHIBIT
3
Bims
2/7/2017 C.A.R.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Case IPR2016-00747
Patent 6,732,147

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 be 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]

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.

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

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.

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.

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

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

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

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:

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.

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.

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:

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

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

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

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.

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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

(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.**[7] **G06F 15/16**
(52) **U.S. Cl.** **709/204**; 709/227
(58) **Field of Search** 709/204, 227, 709/217

(56) **References Cited**

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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).

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

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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

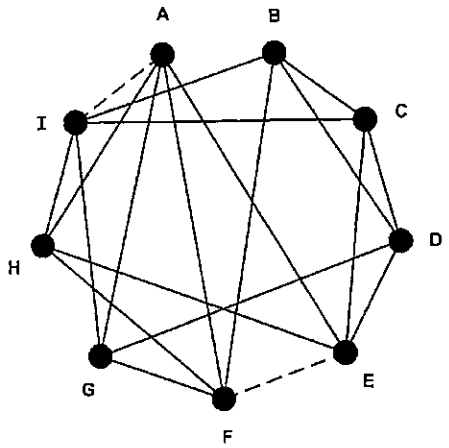

EXHIBIT
4
Bims
2/7/2017 CAR.

EXHIBIT
Ex. 1001

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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

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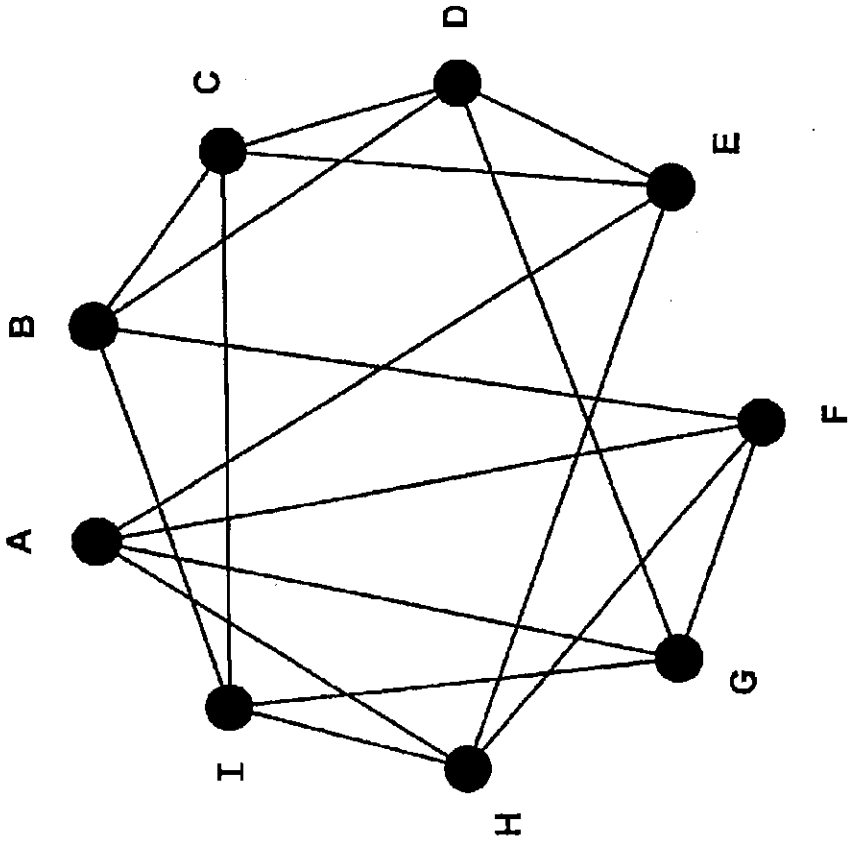


Fig. 1

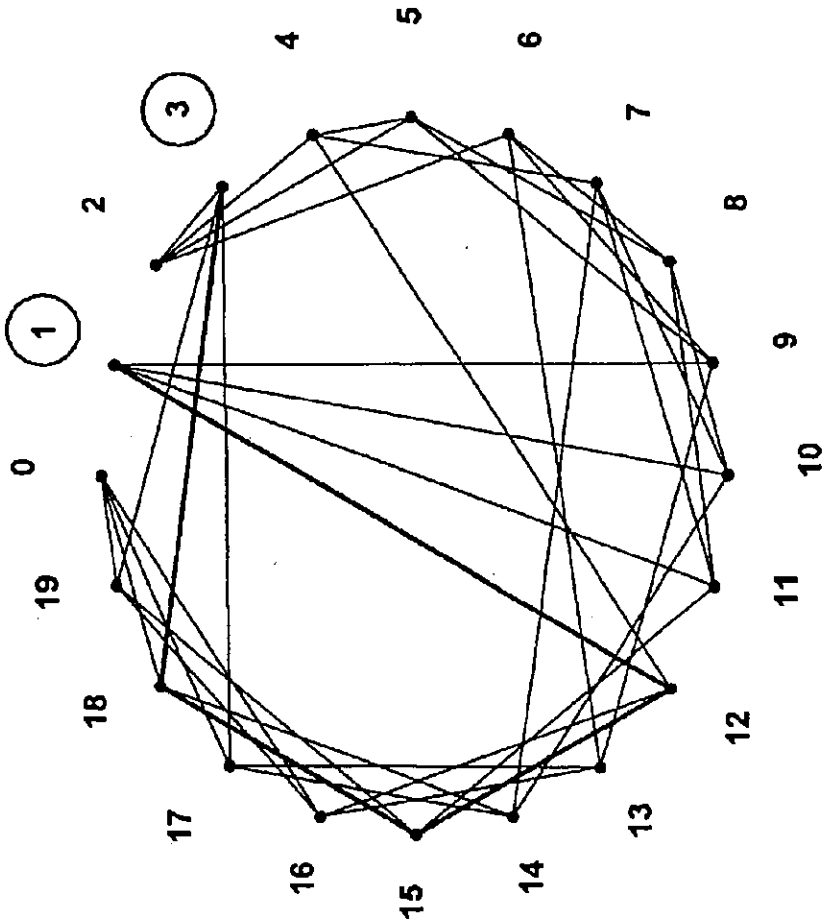


Fig. 2

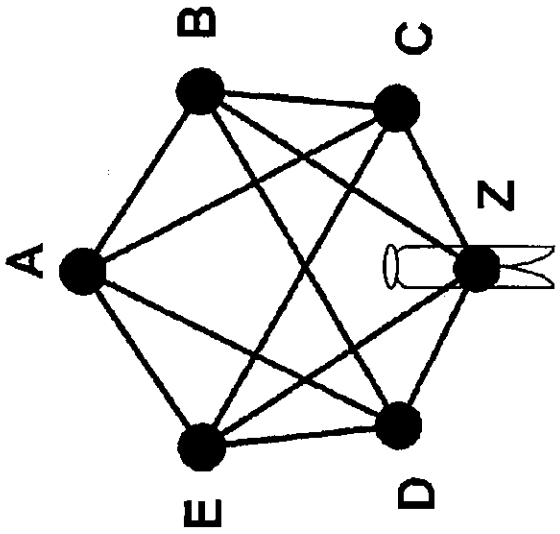


Fig. 3B

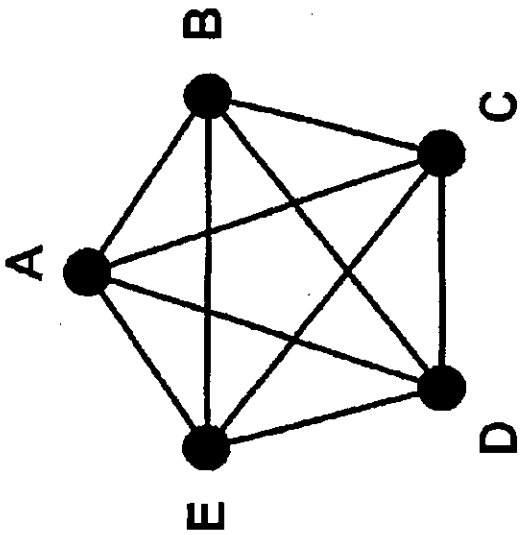


Fig. 3A

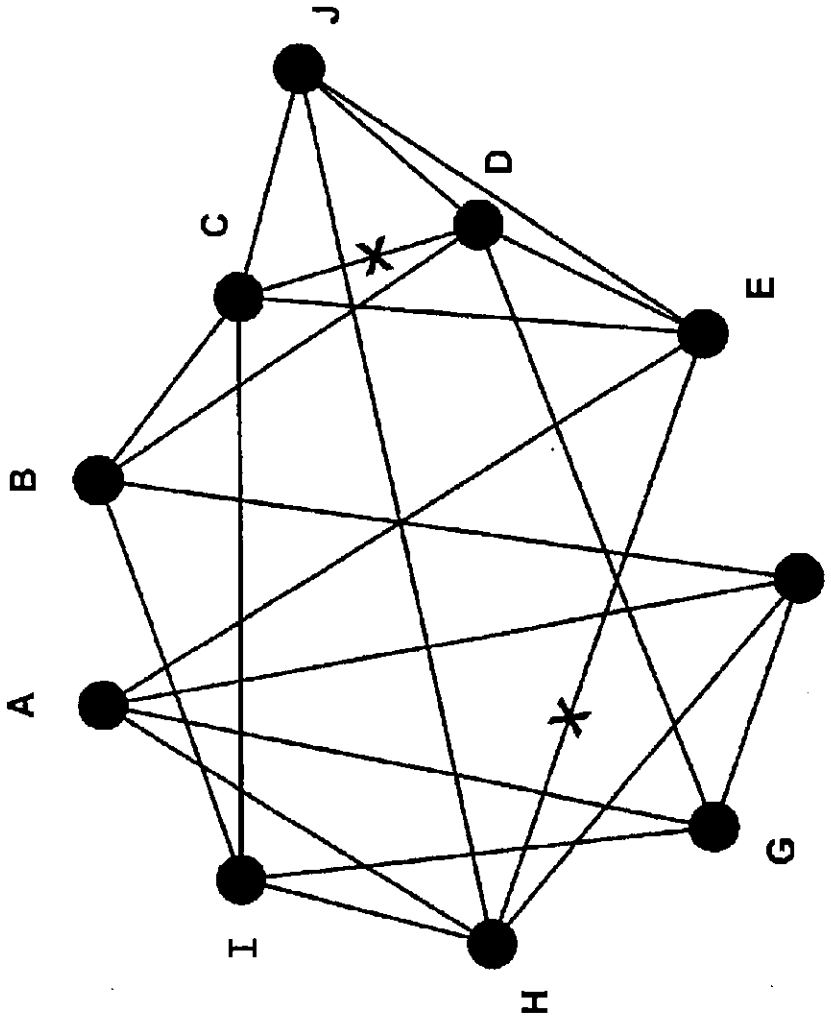


Fig. 4A

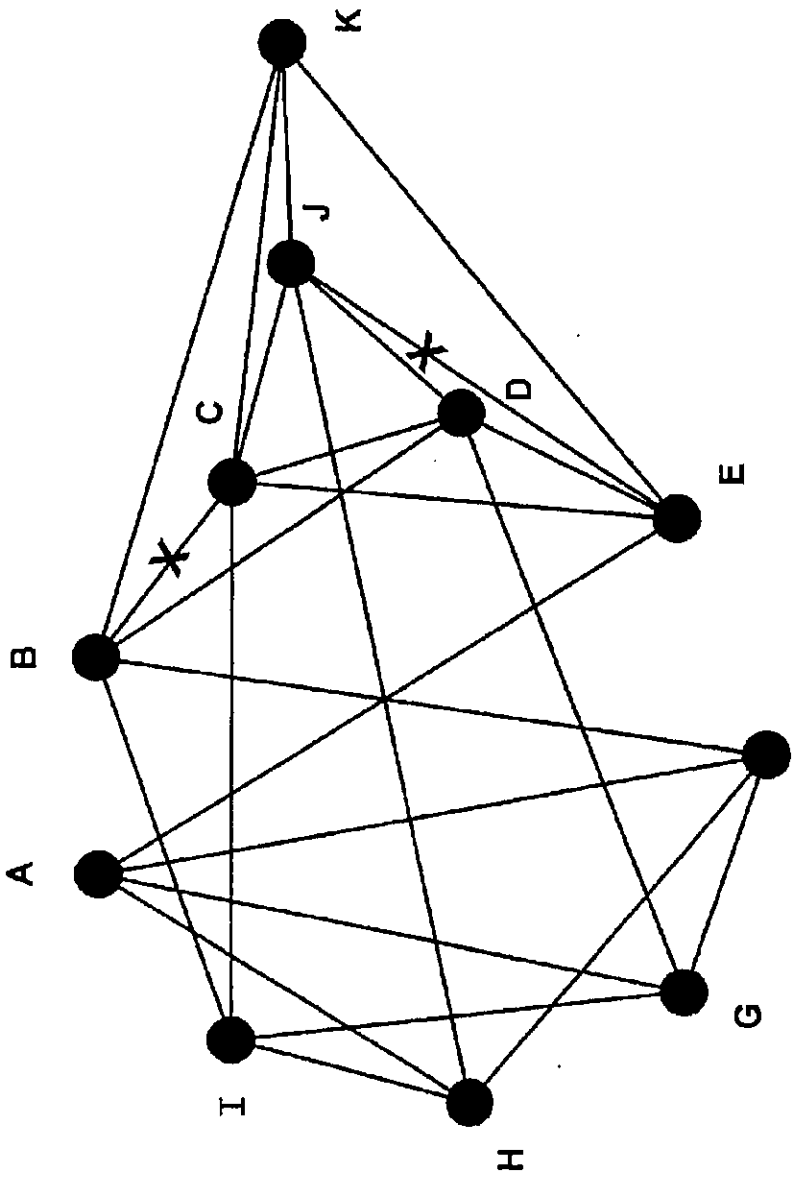


Fig. 4B

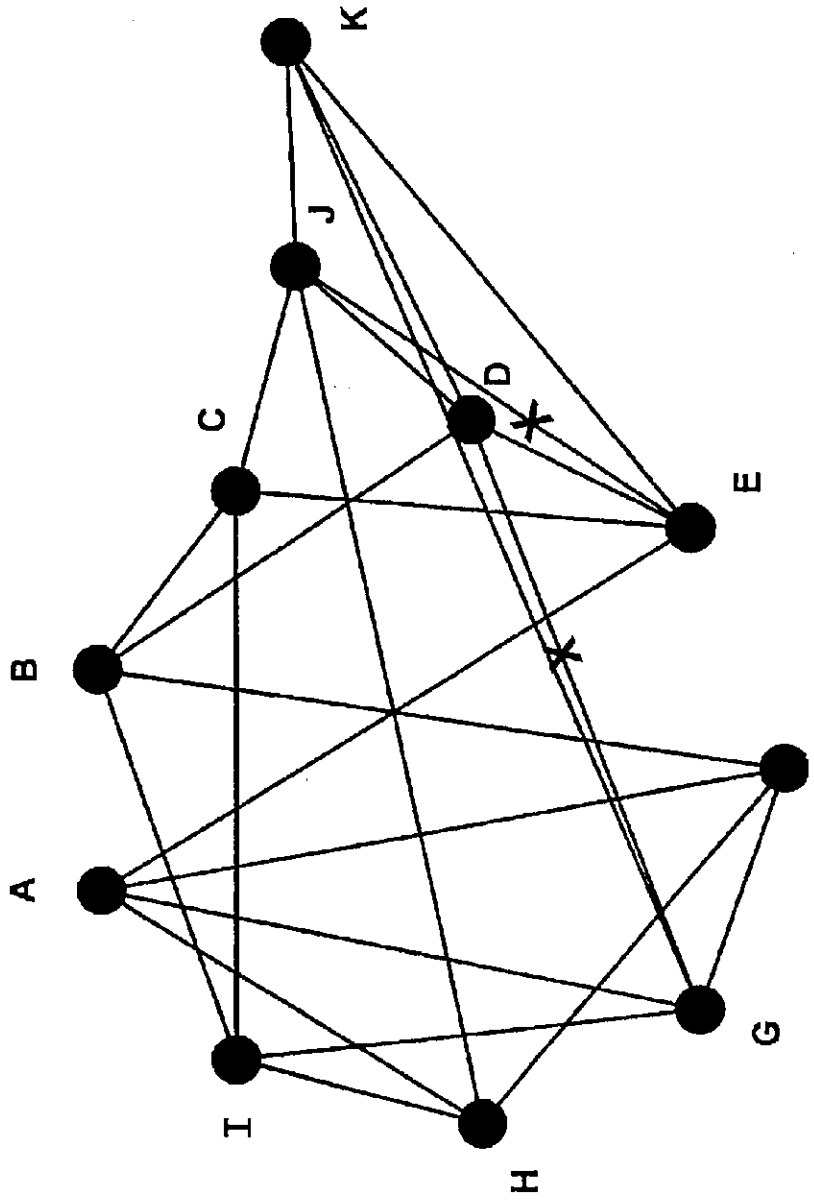


Fig. 4C

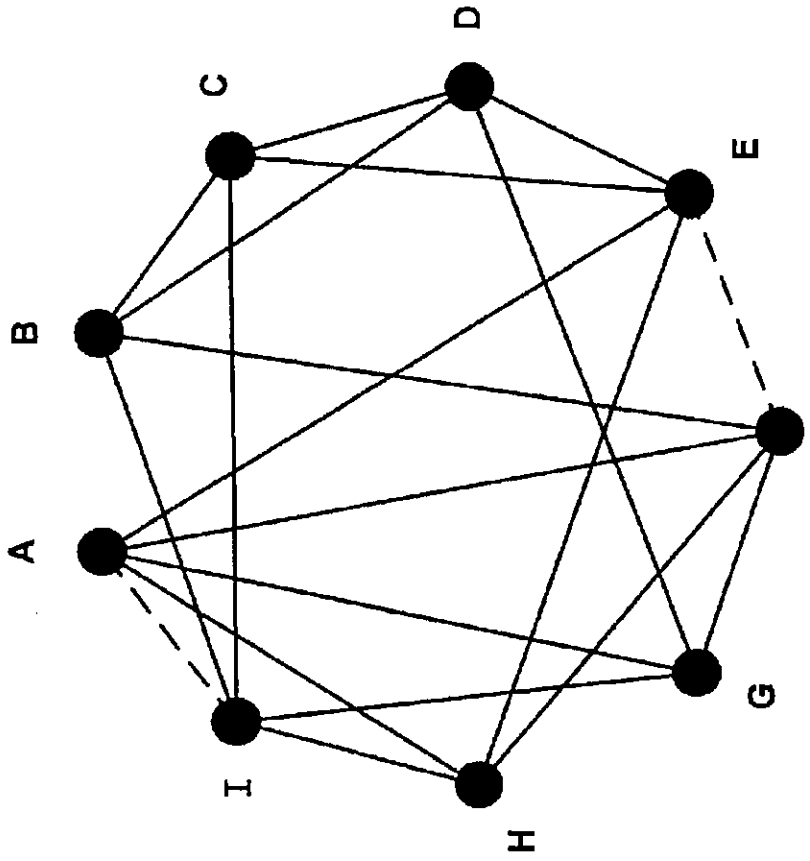


Fig. 5A

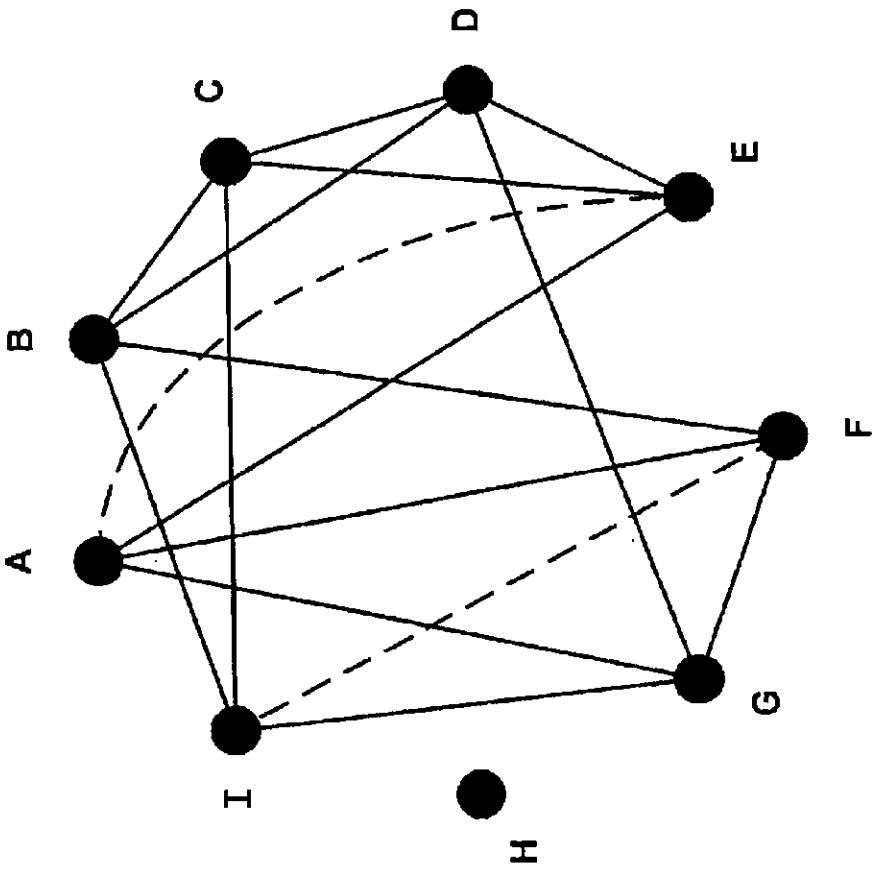


Fig. 5B

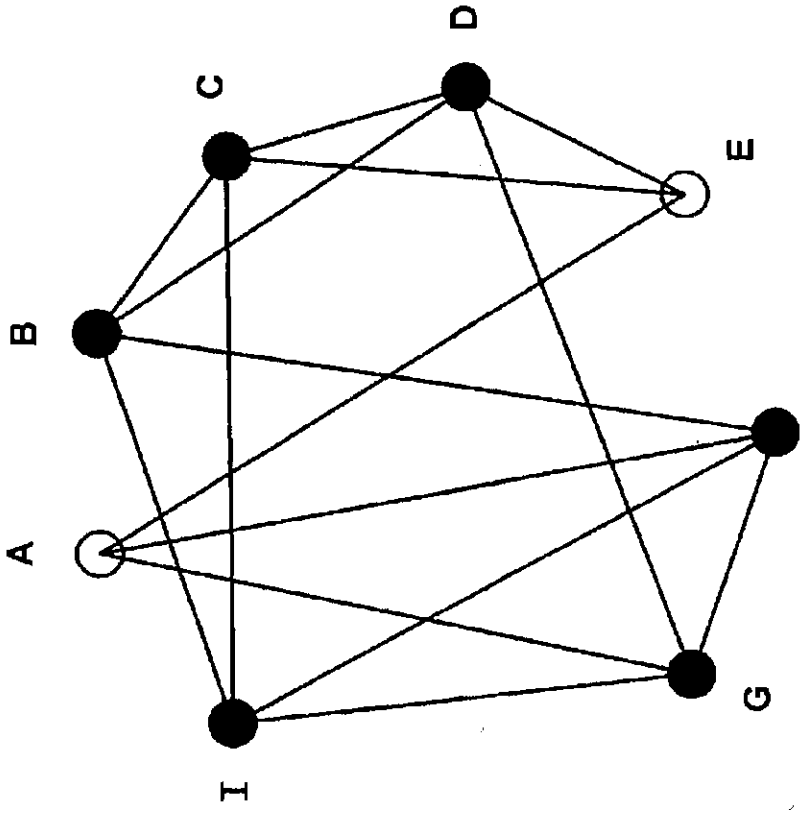


Fig. 5C

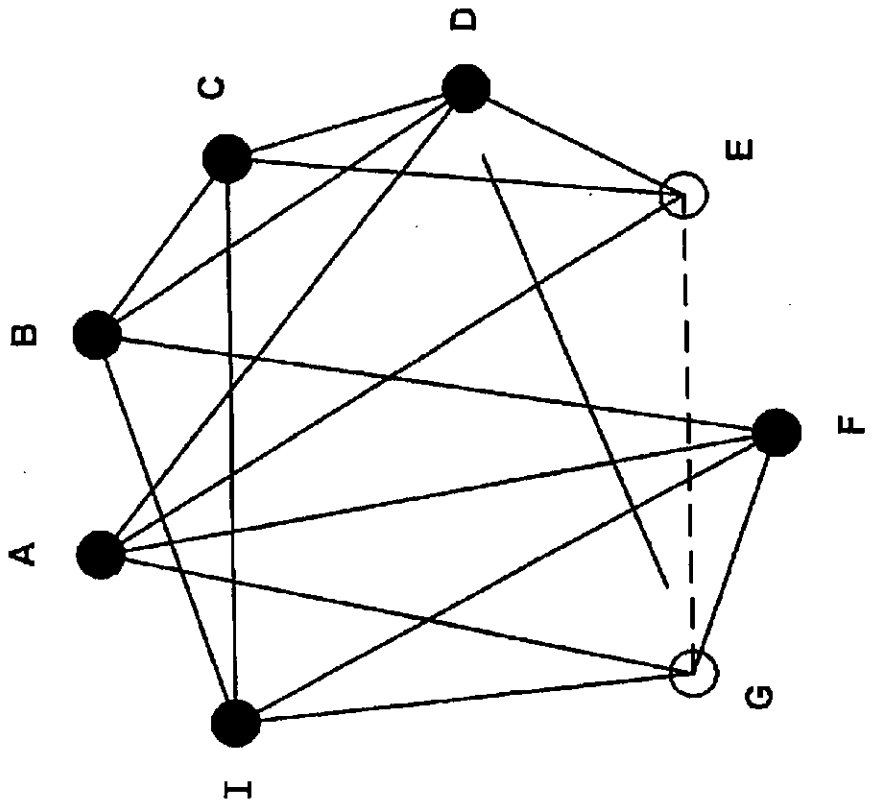


Fig. 5D

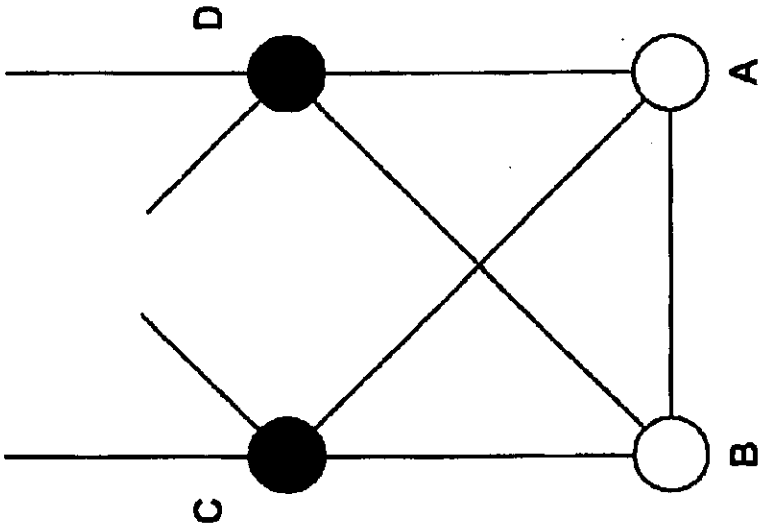


Fig. 5F

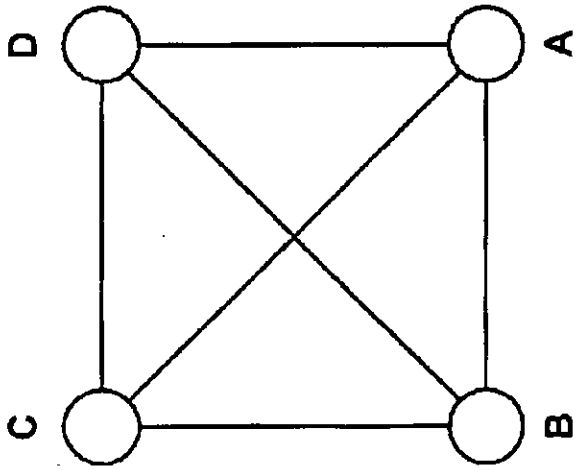


Fig. 5E

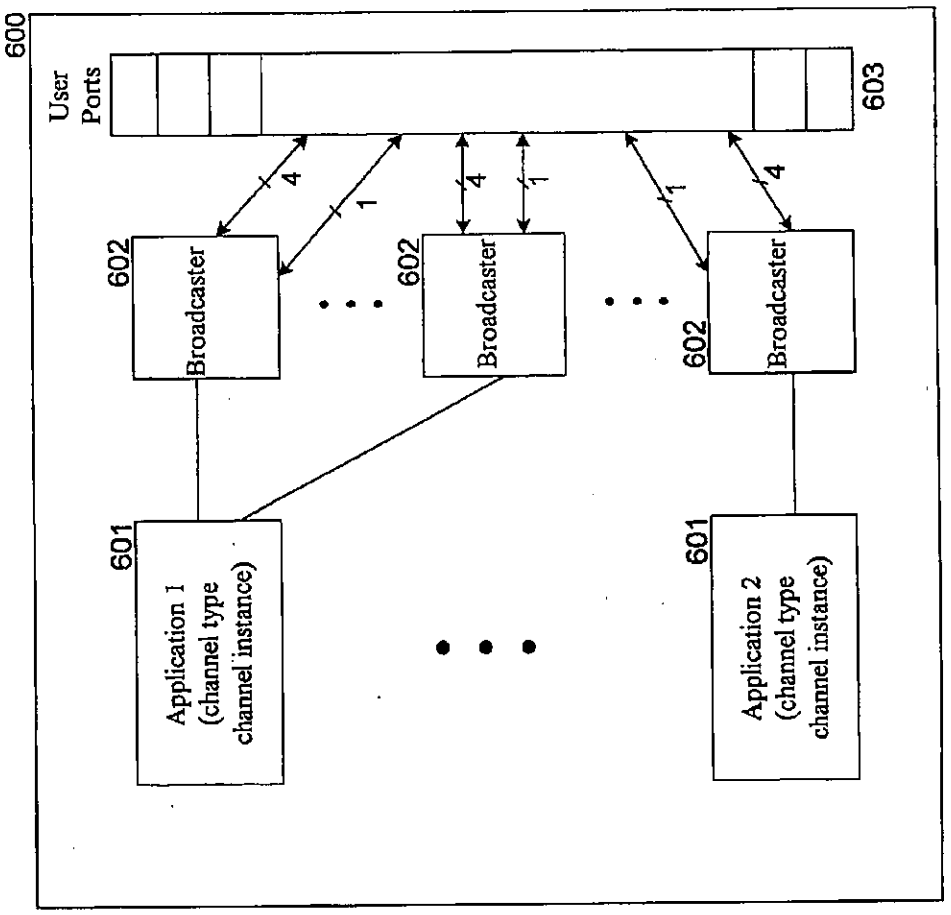

600
User Ports
603
4
1
4
1
1
4
602
Broadcaster
602
Broadcaster
602
Broadcaster
601
Application 1 (channel type channel instance)
601
Application 2 (channel type channel instance)

Fig. 6

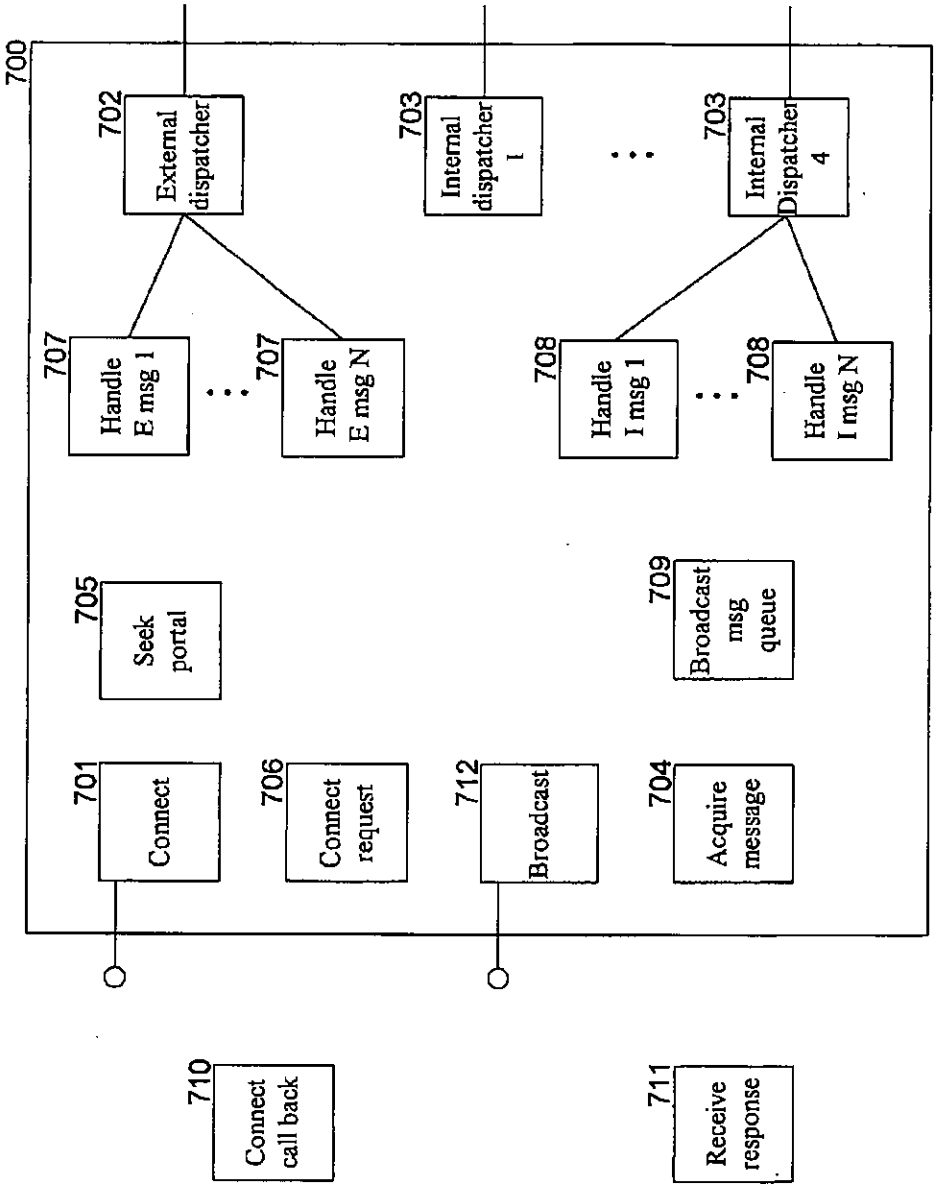


Fig. 7

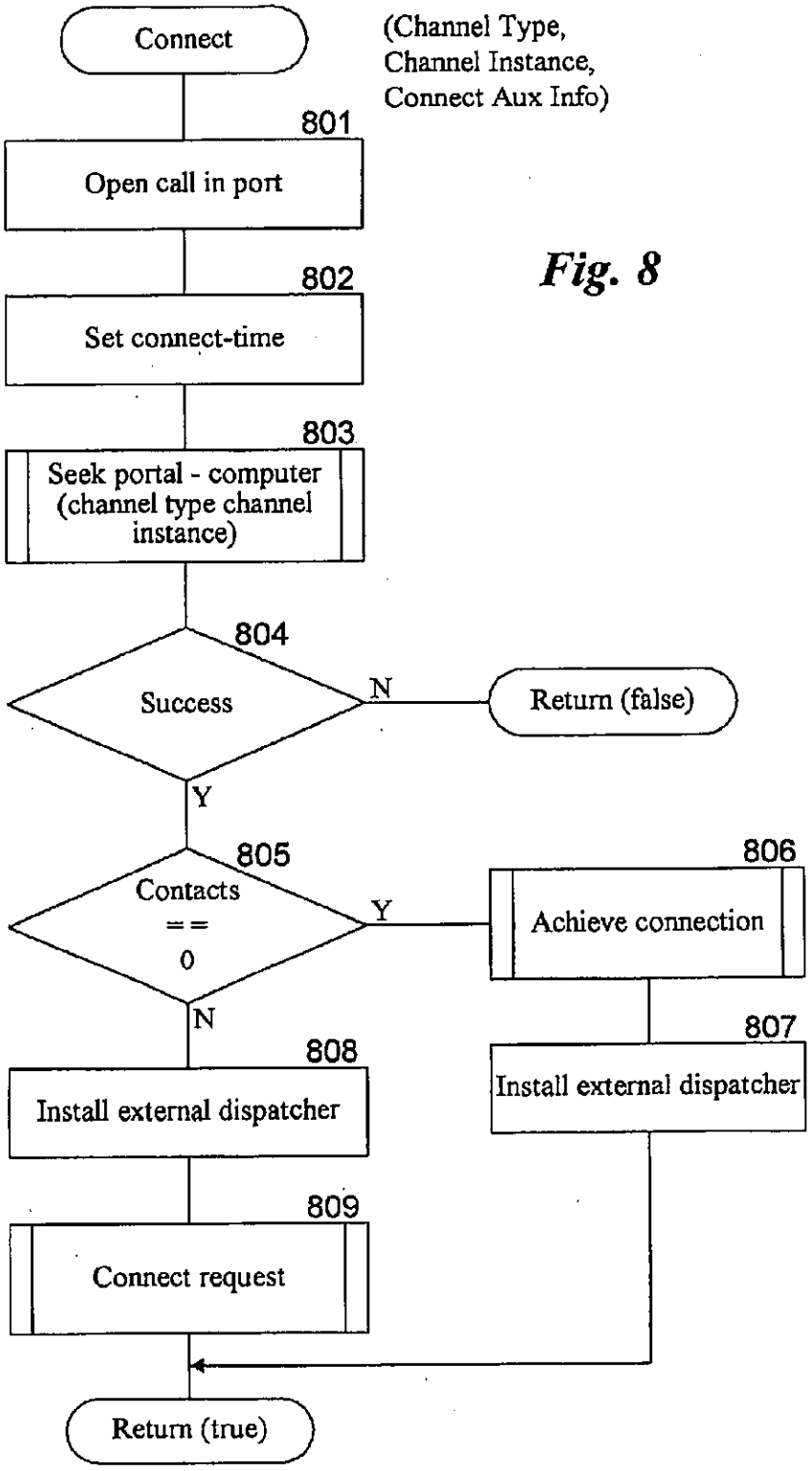


Fig. 8

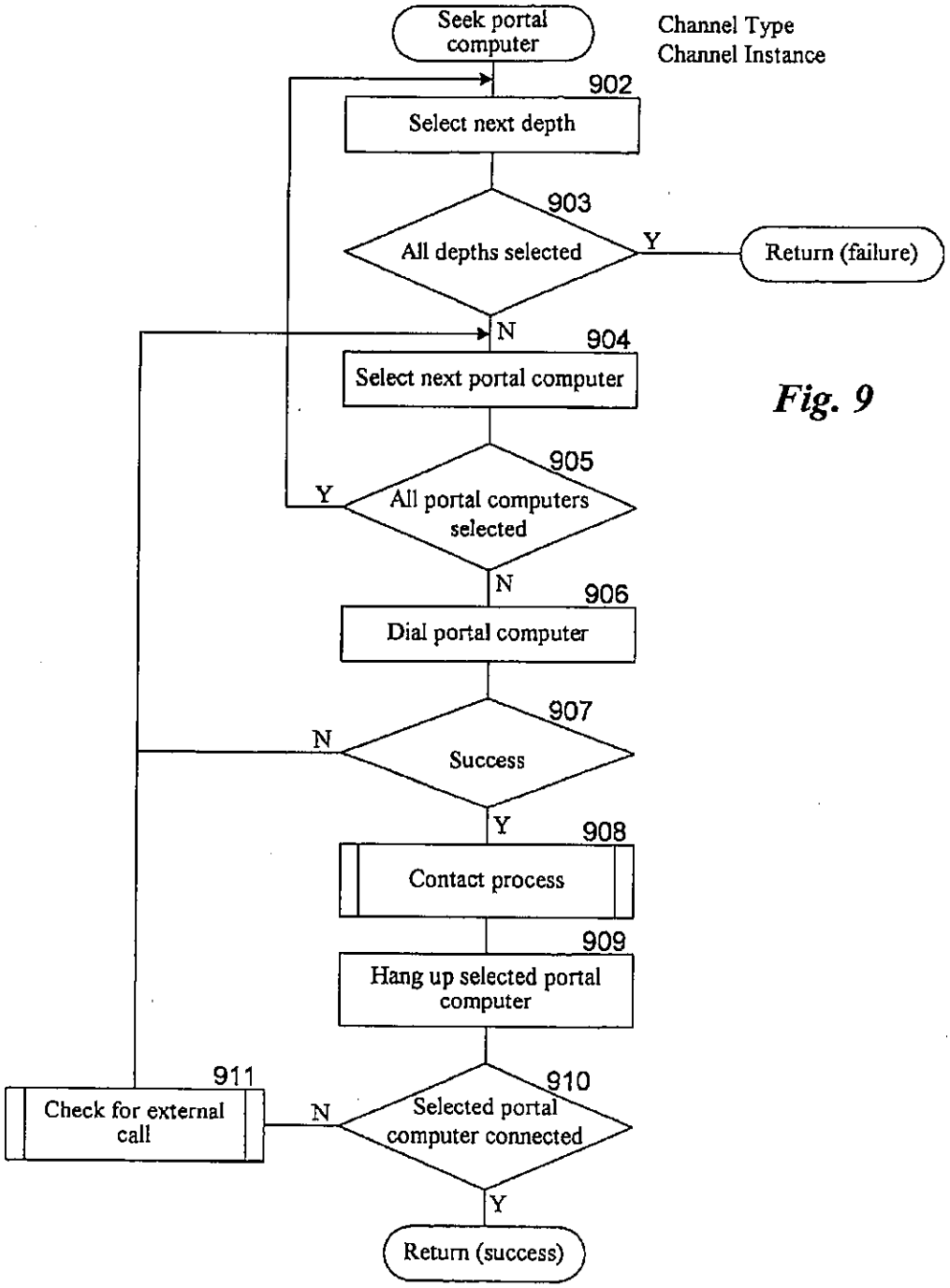


Fig. 9

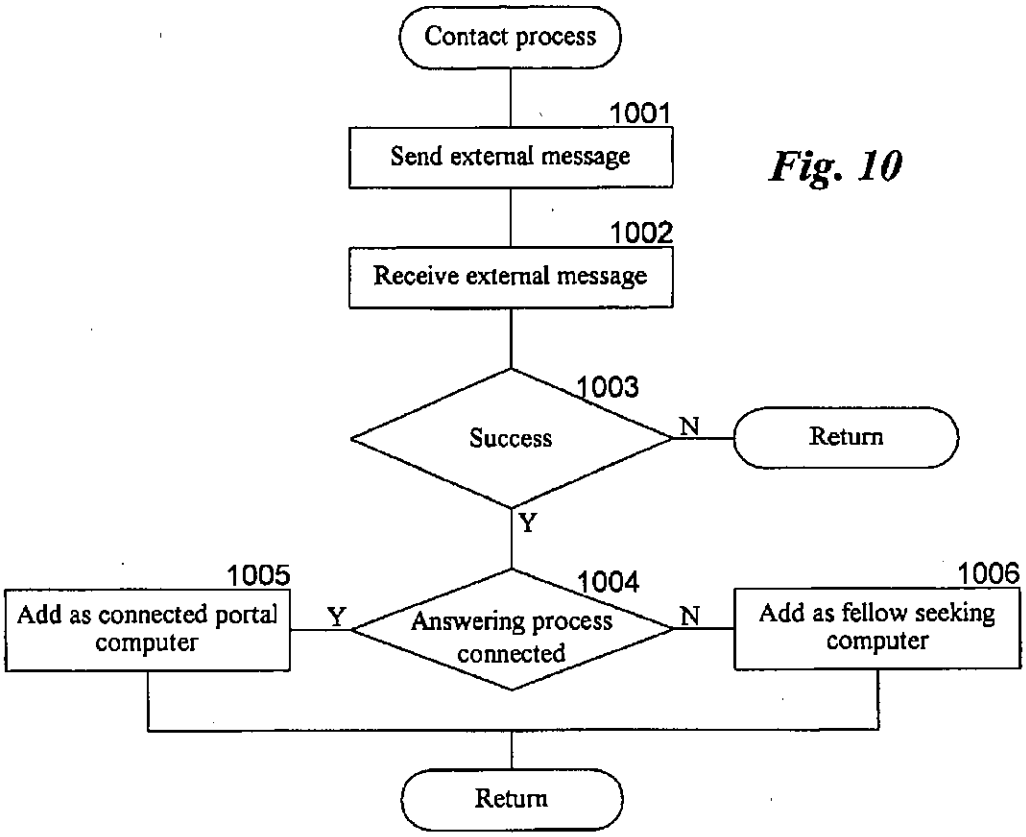
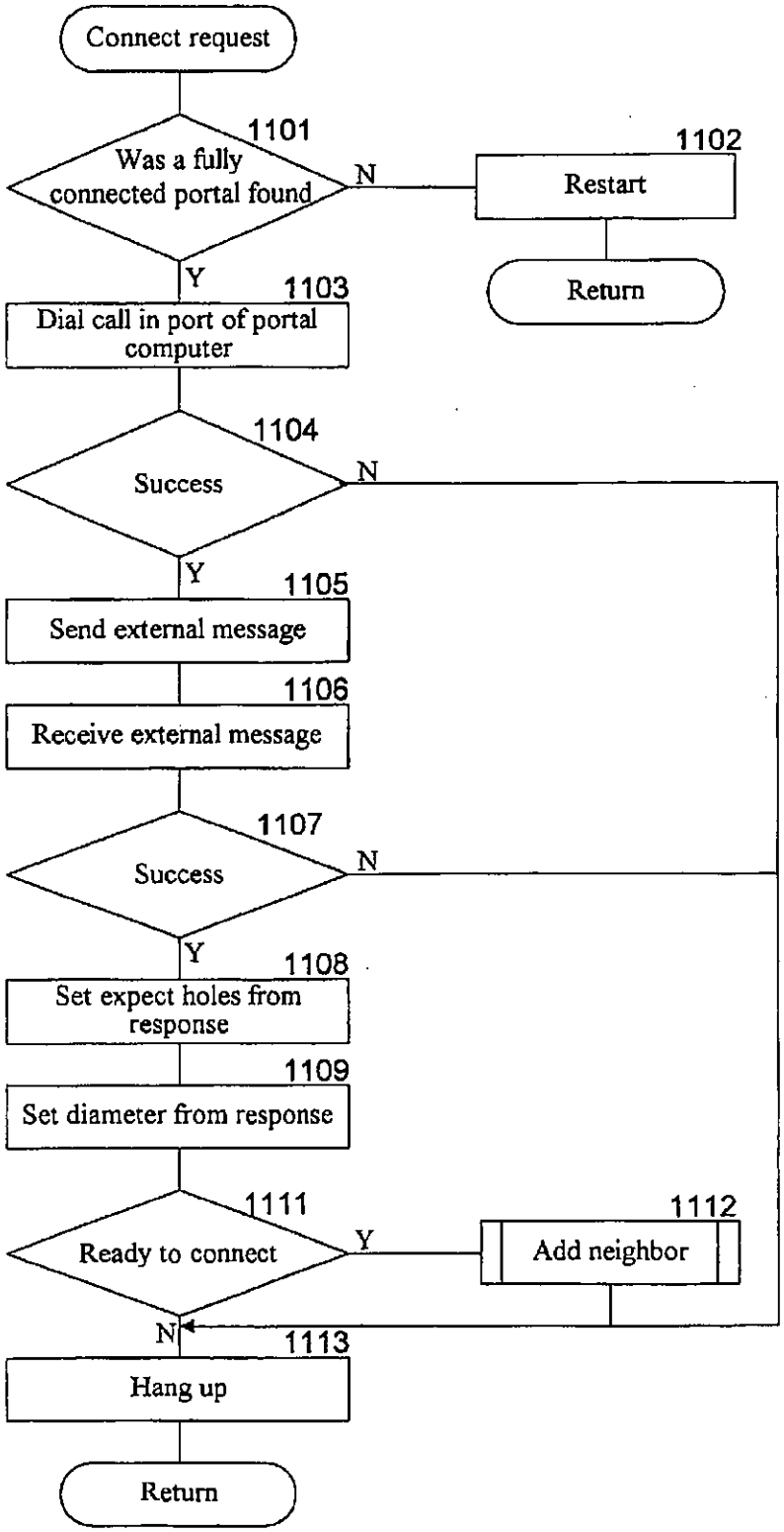

Contact process
1001
Send external message
1002
Receive external message
1003
Success
N
Return
Y
1005
Add as connected portal computer
Y
1004
Answering process connected
N
1006
Add as fellow seeking computer
Return

Fig. 10

Fig. 11



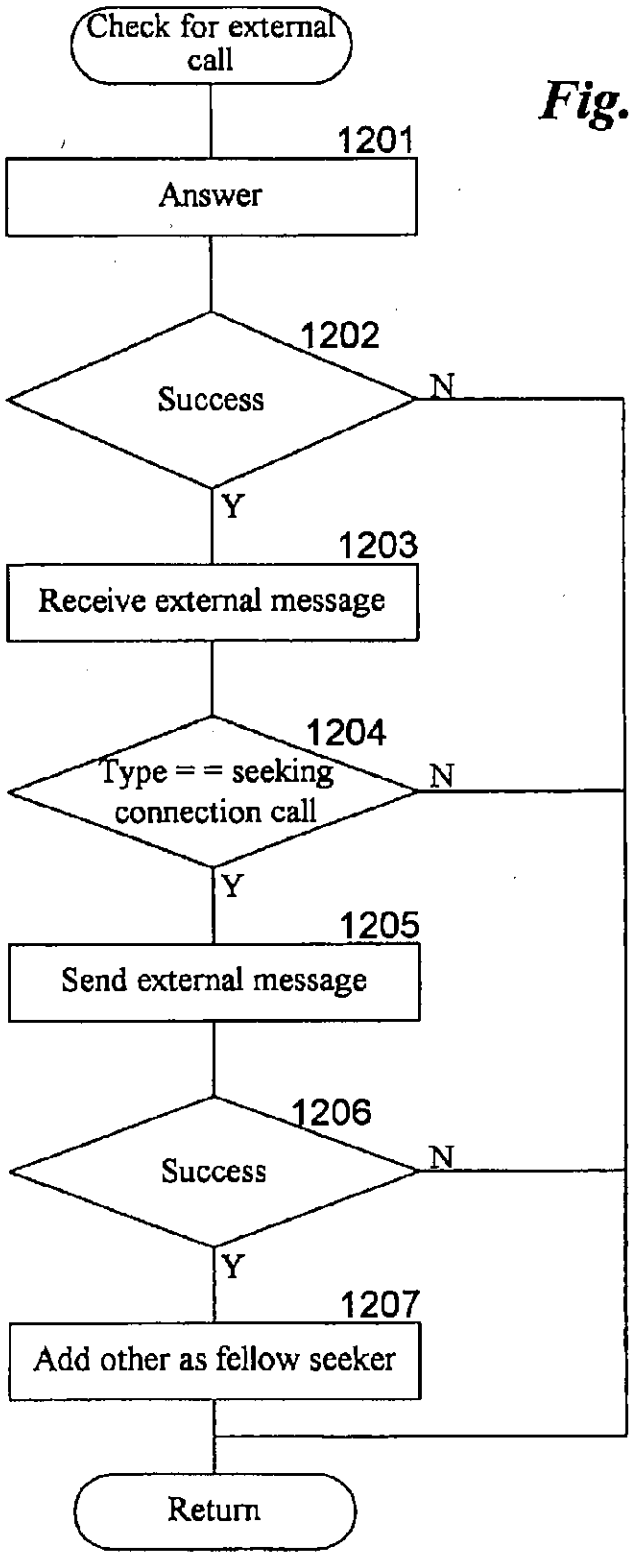


Fig. 12

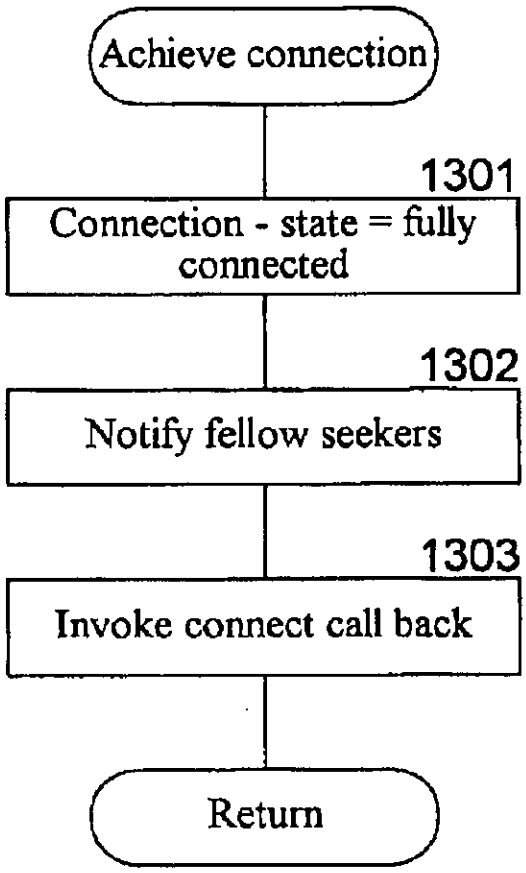
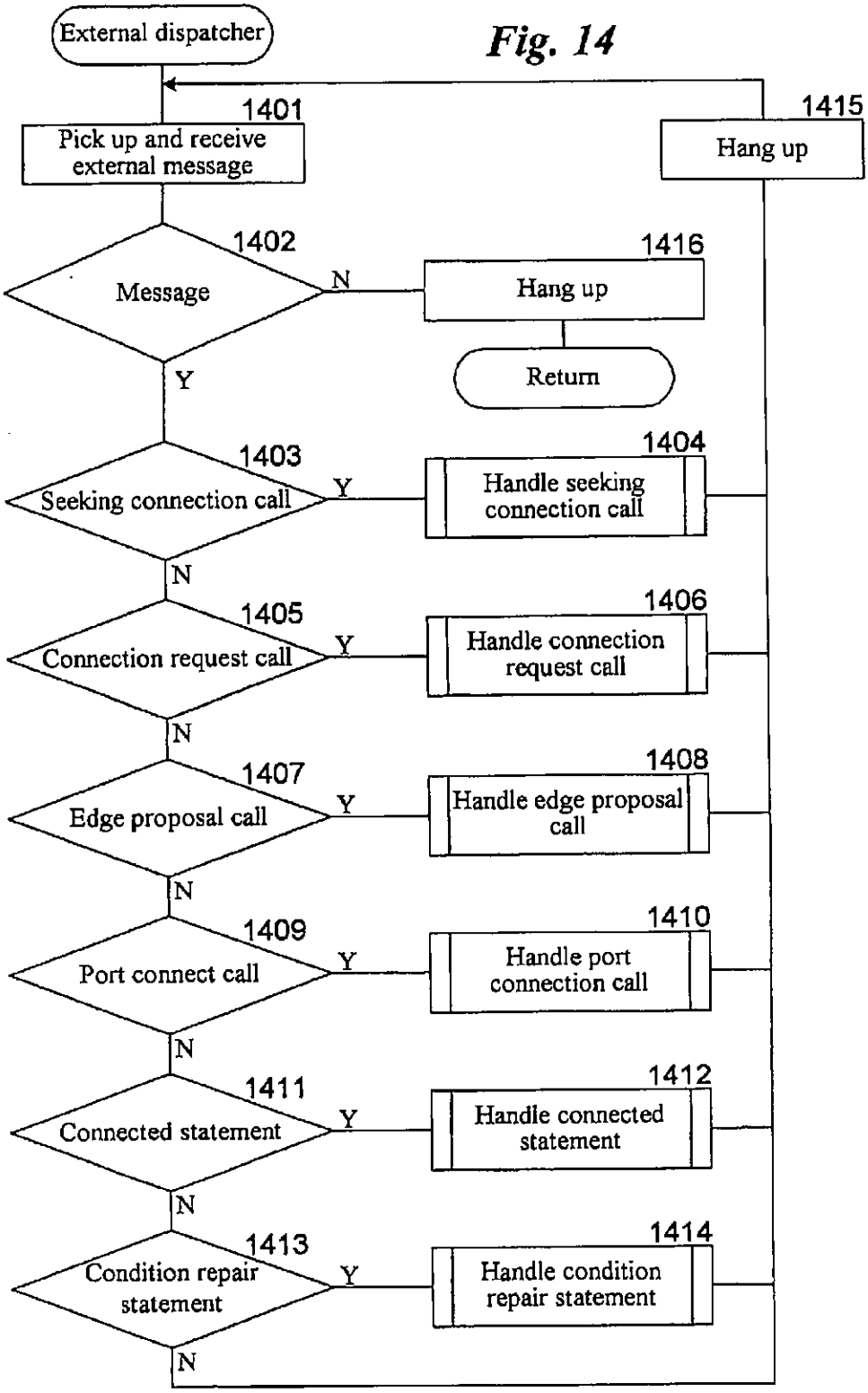


Fig. 13

Fig. 14



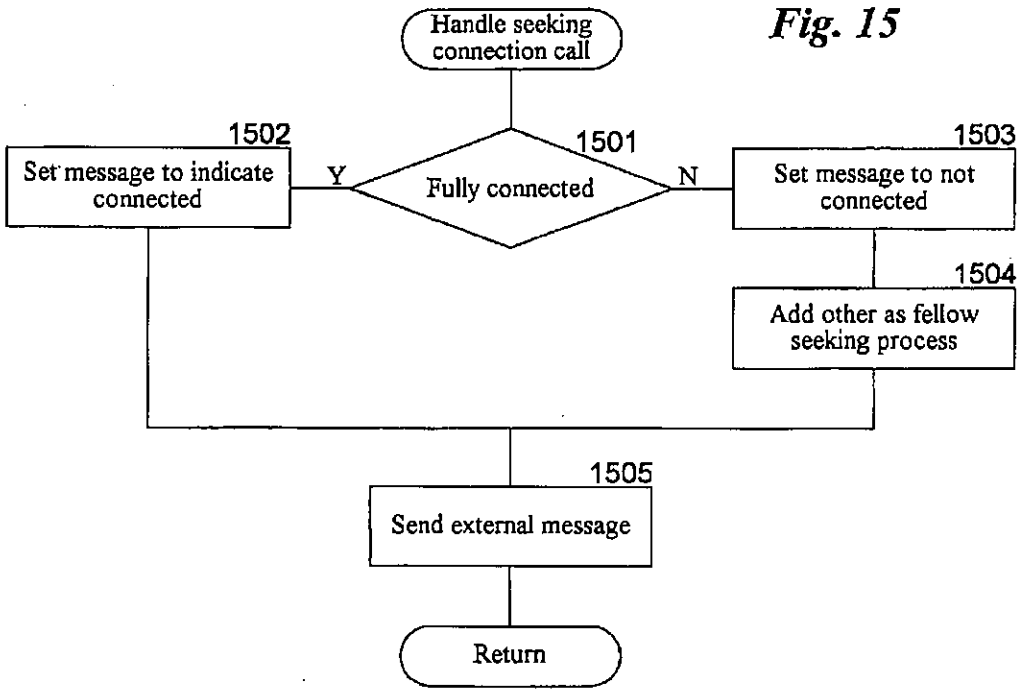


Fig. 15

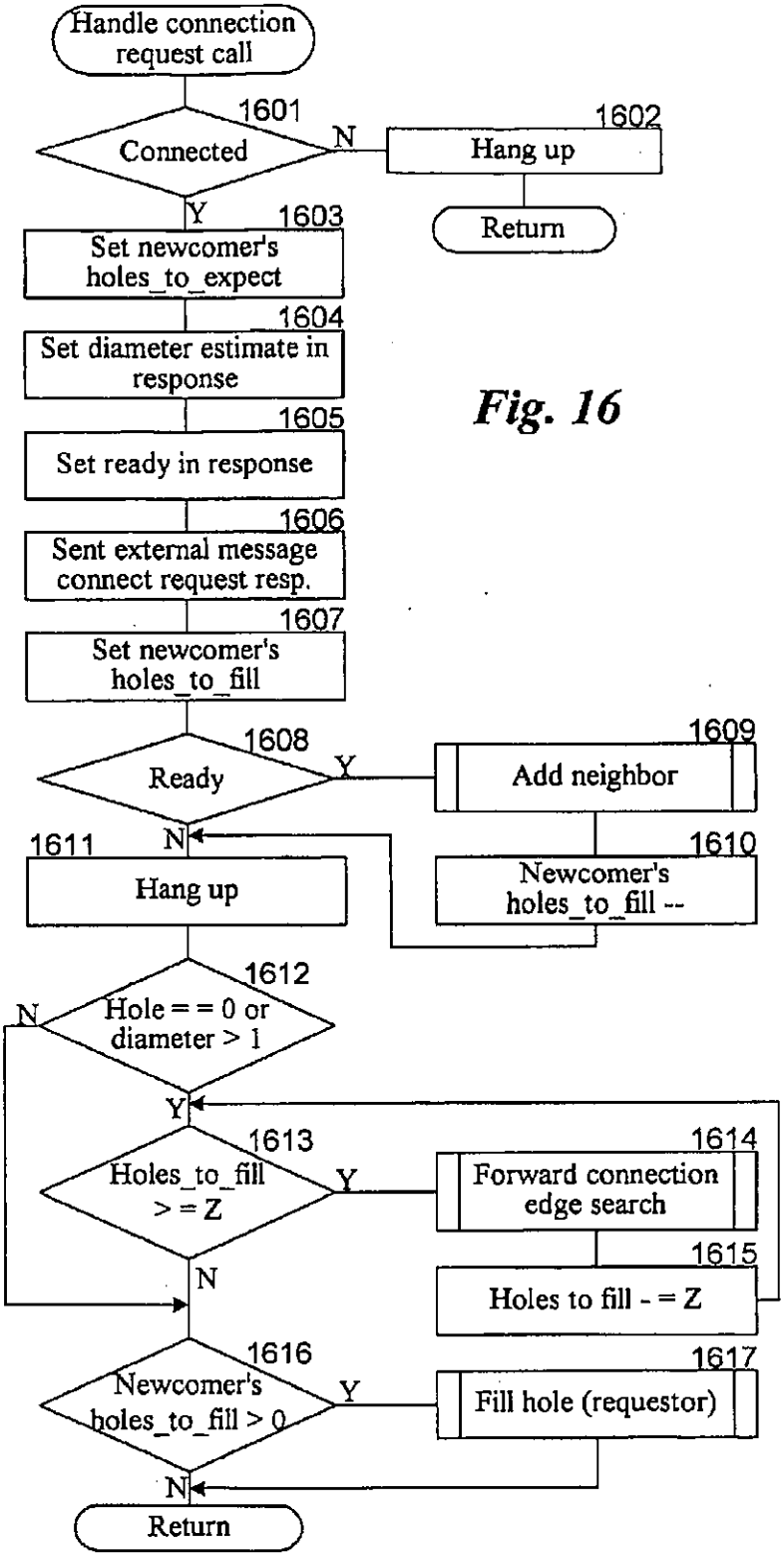


Fig. 16

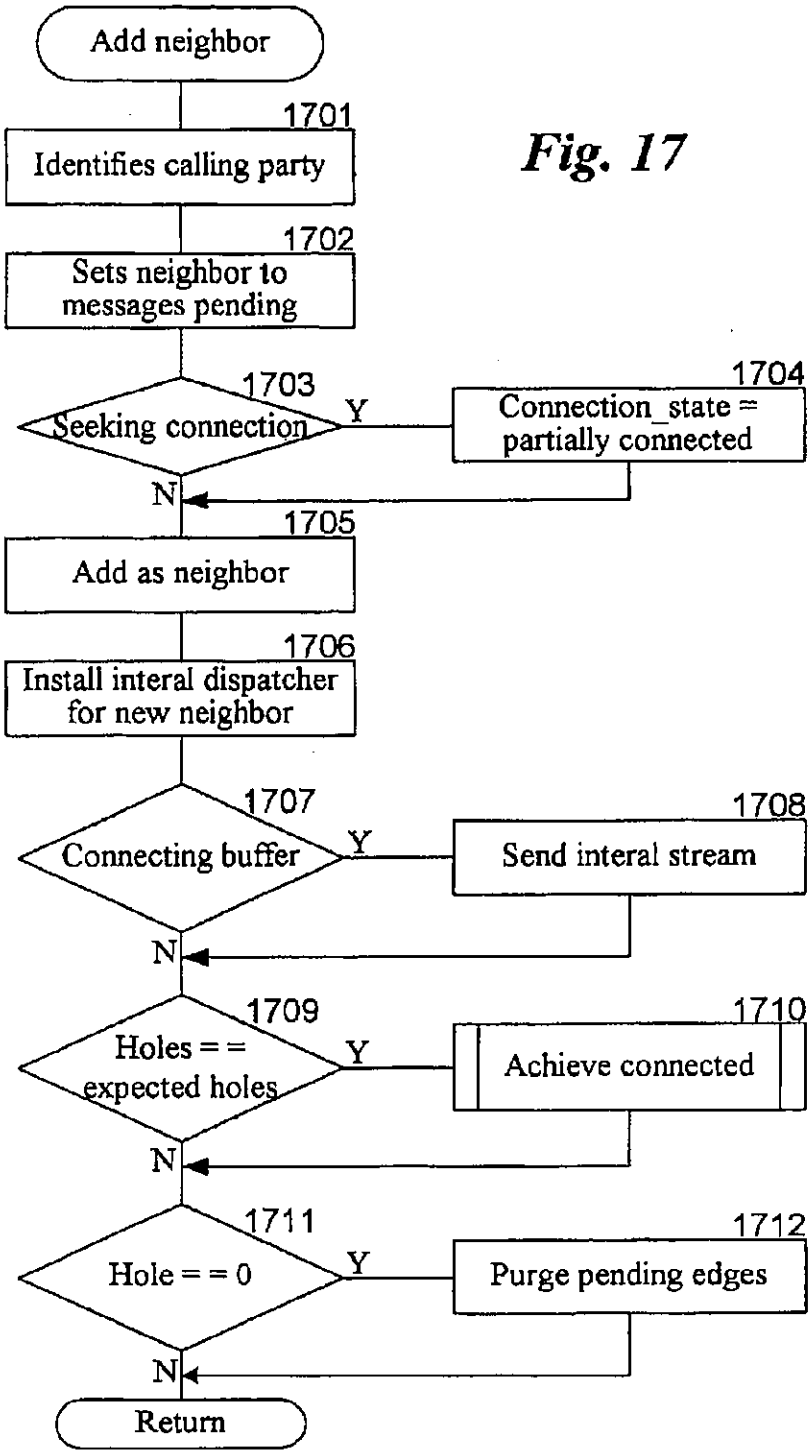
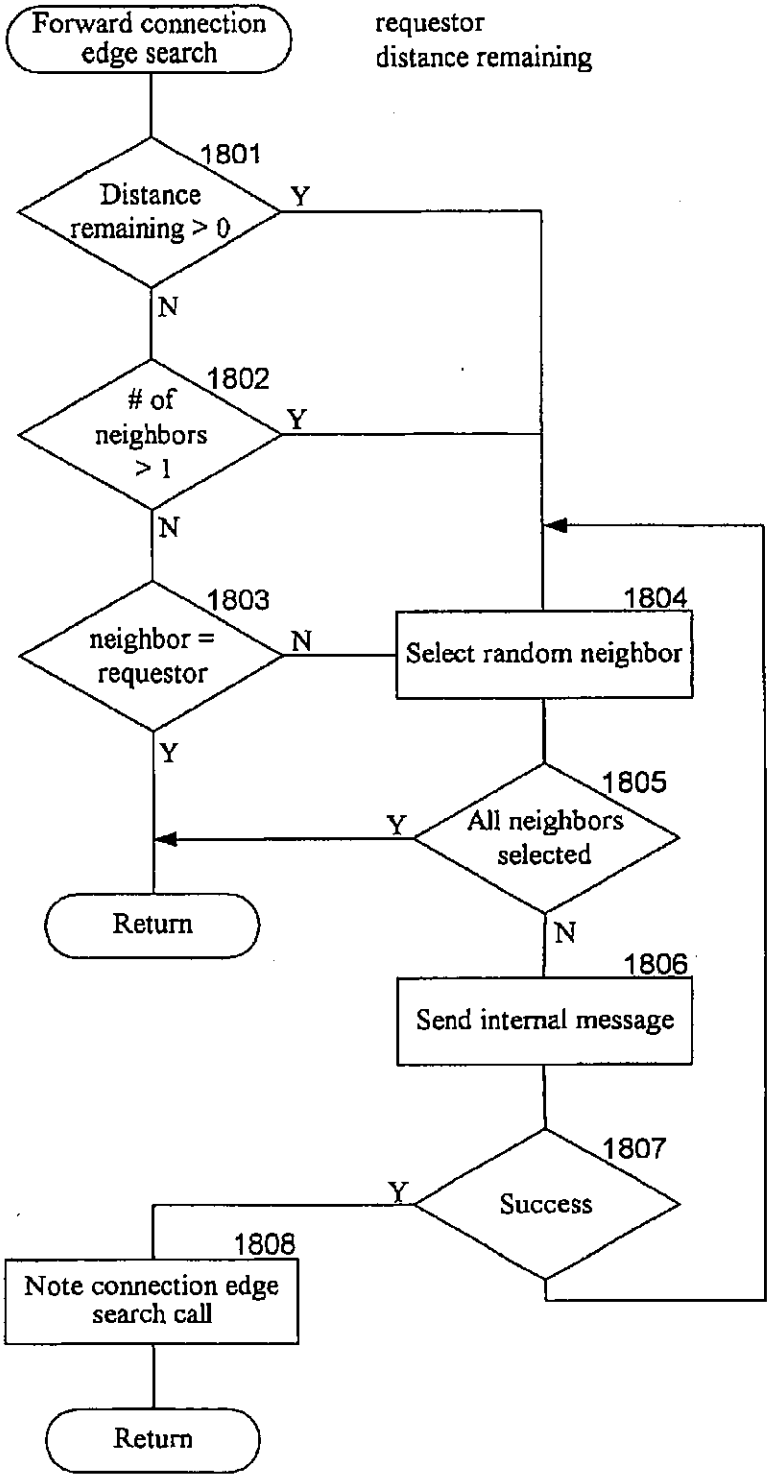


Fig. 17

Fig. 18



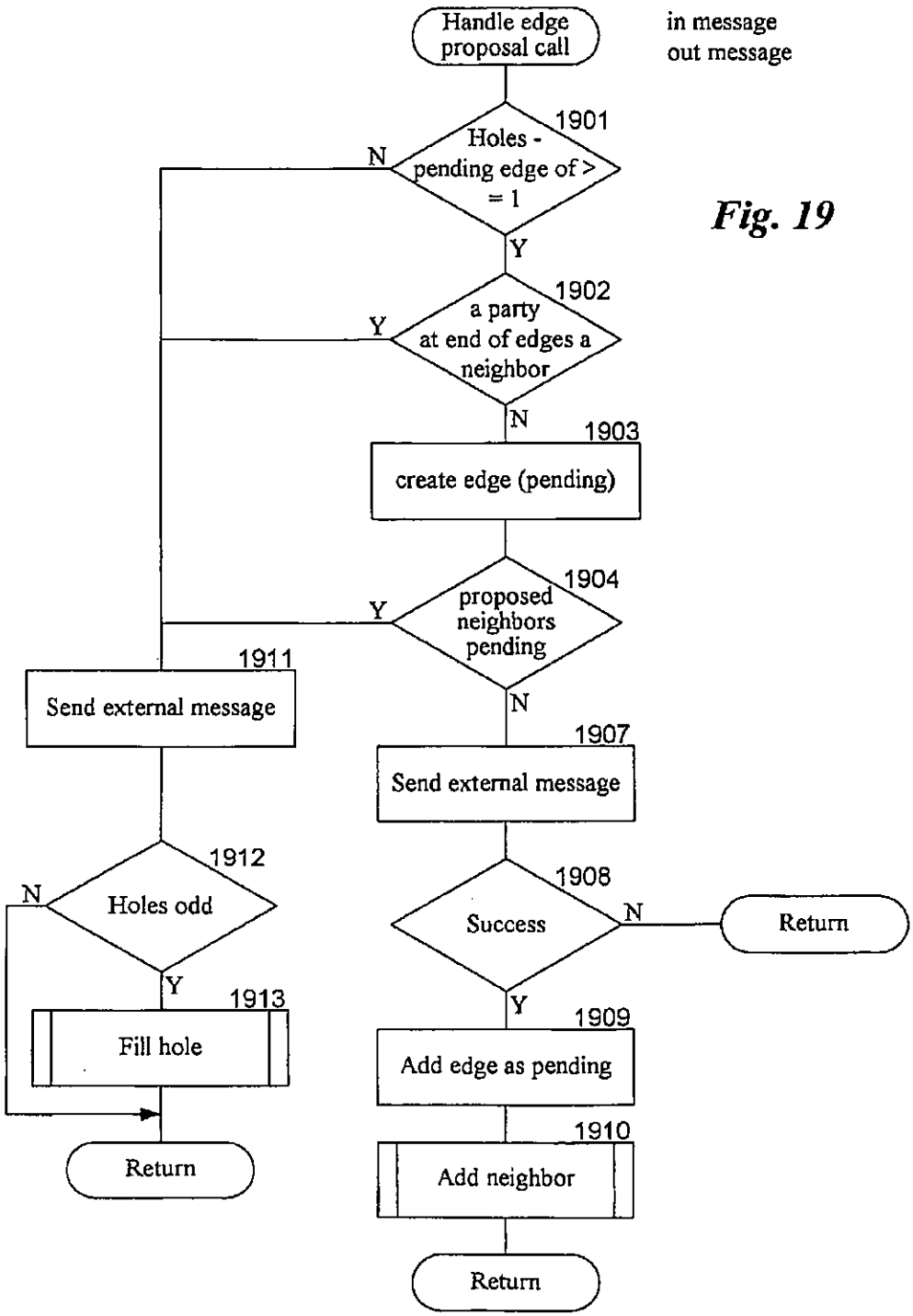


Fig. 19

Fig. 20

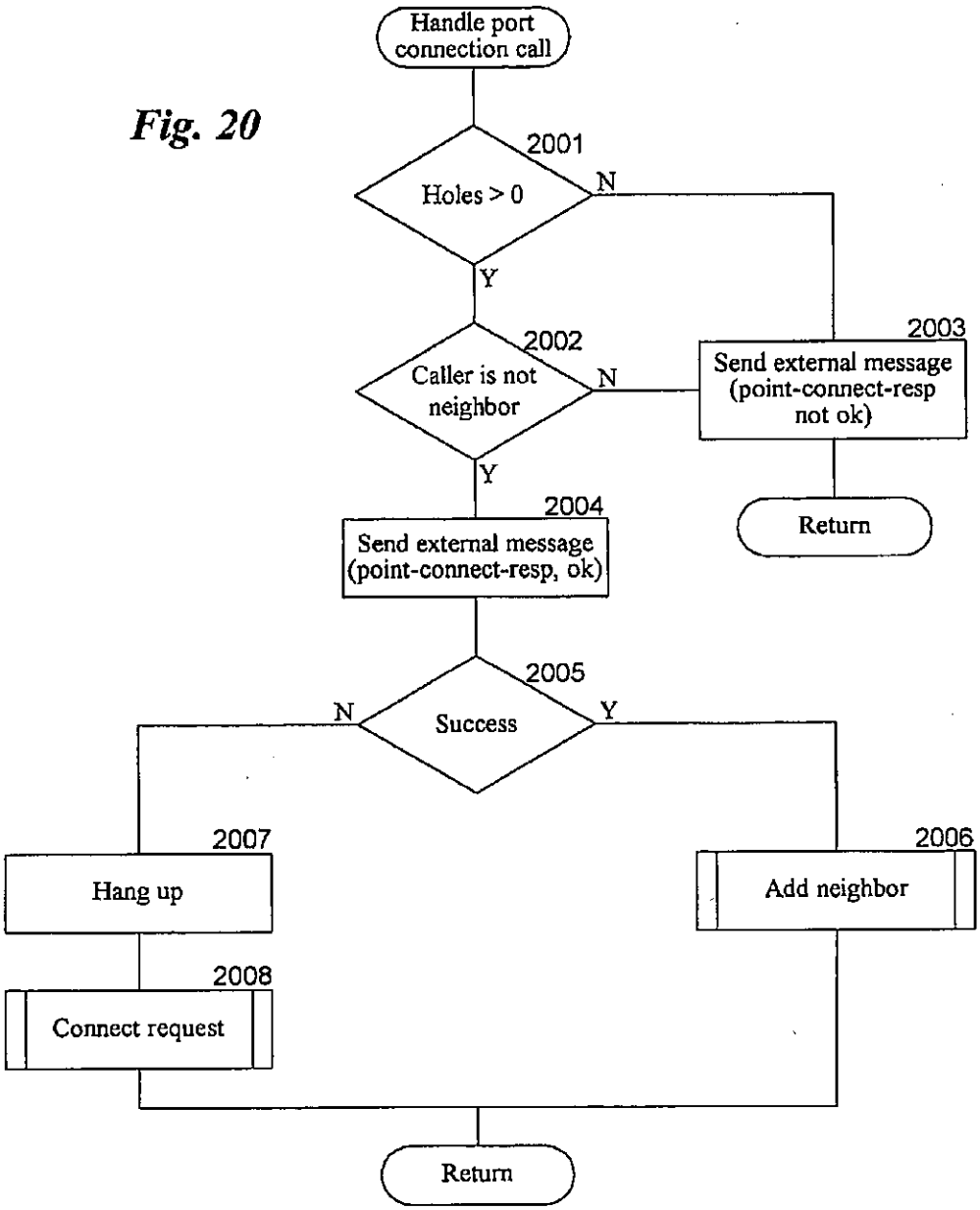


Fig. 21

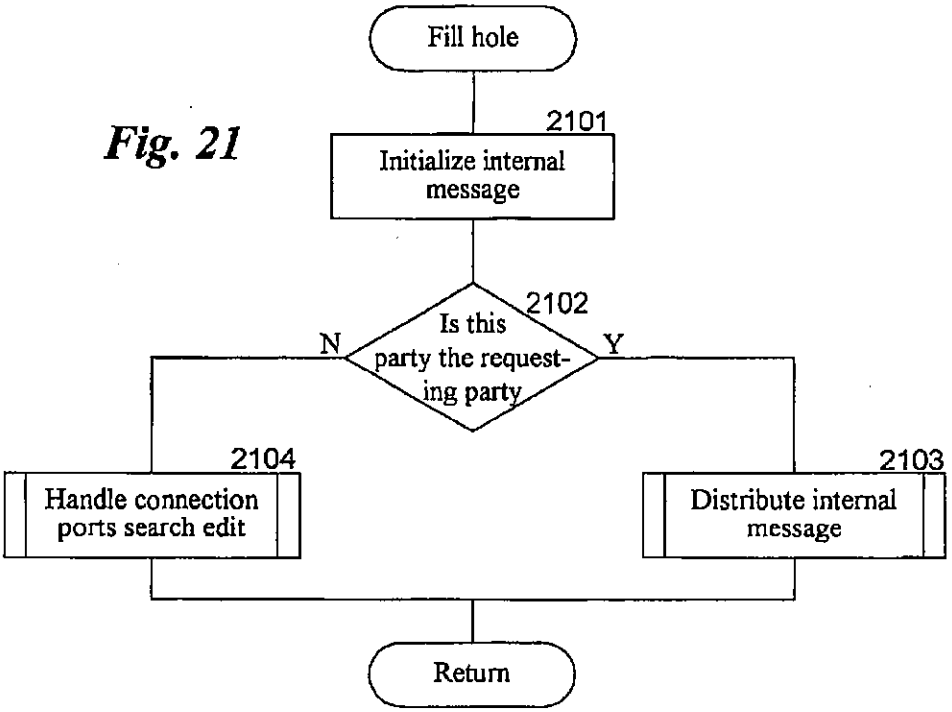


Fig. 22

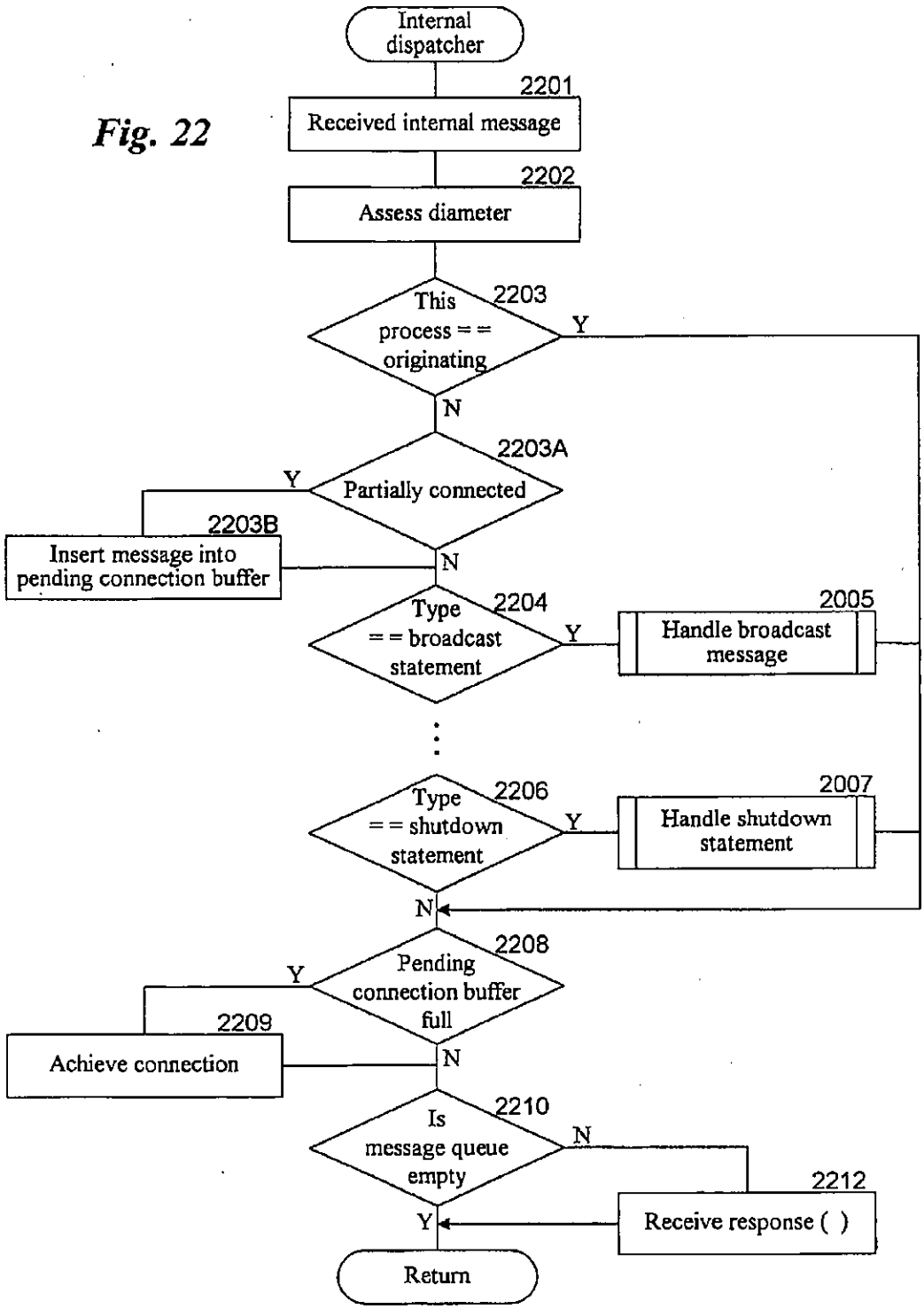


Fig. 23

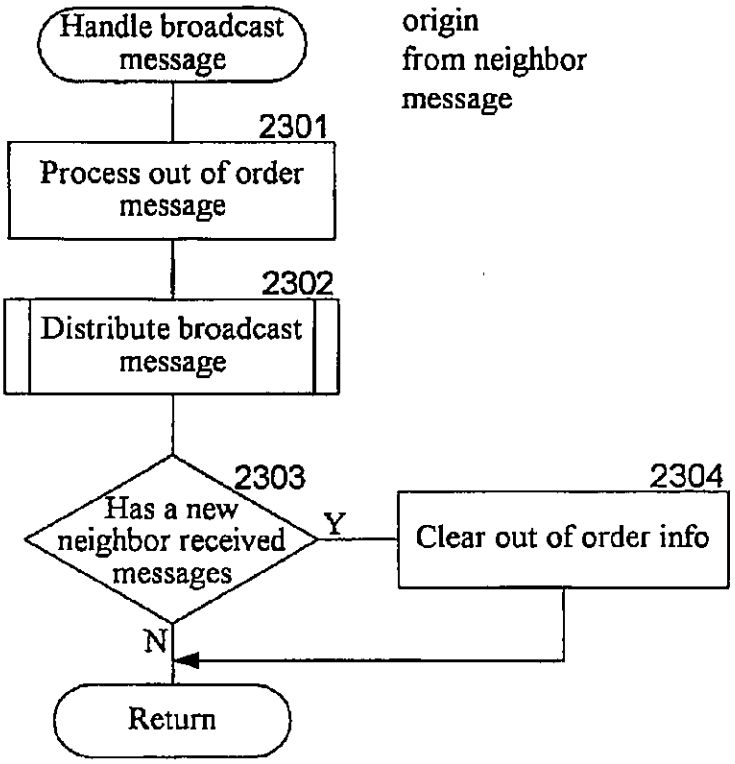
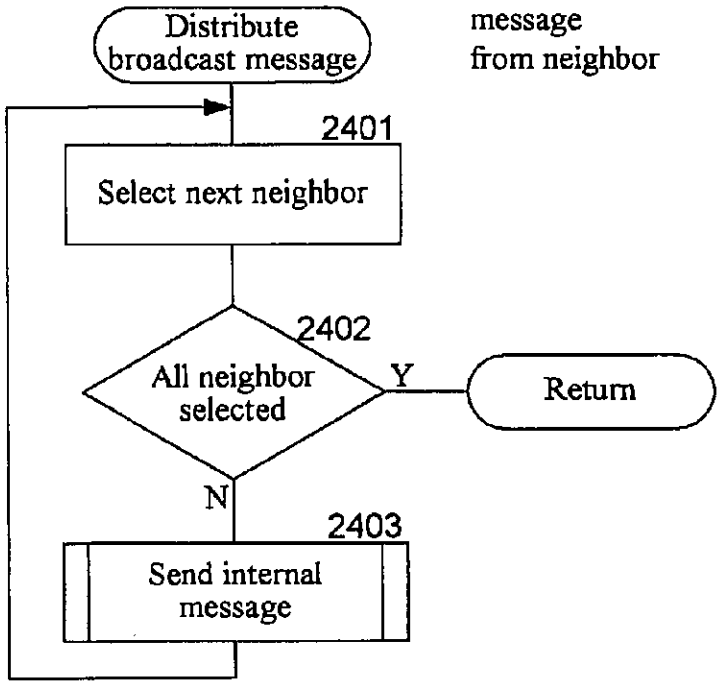


Fig. 24



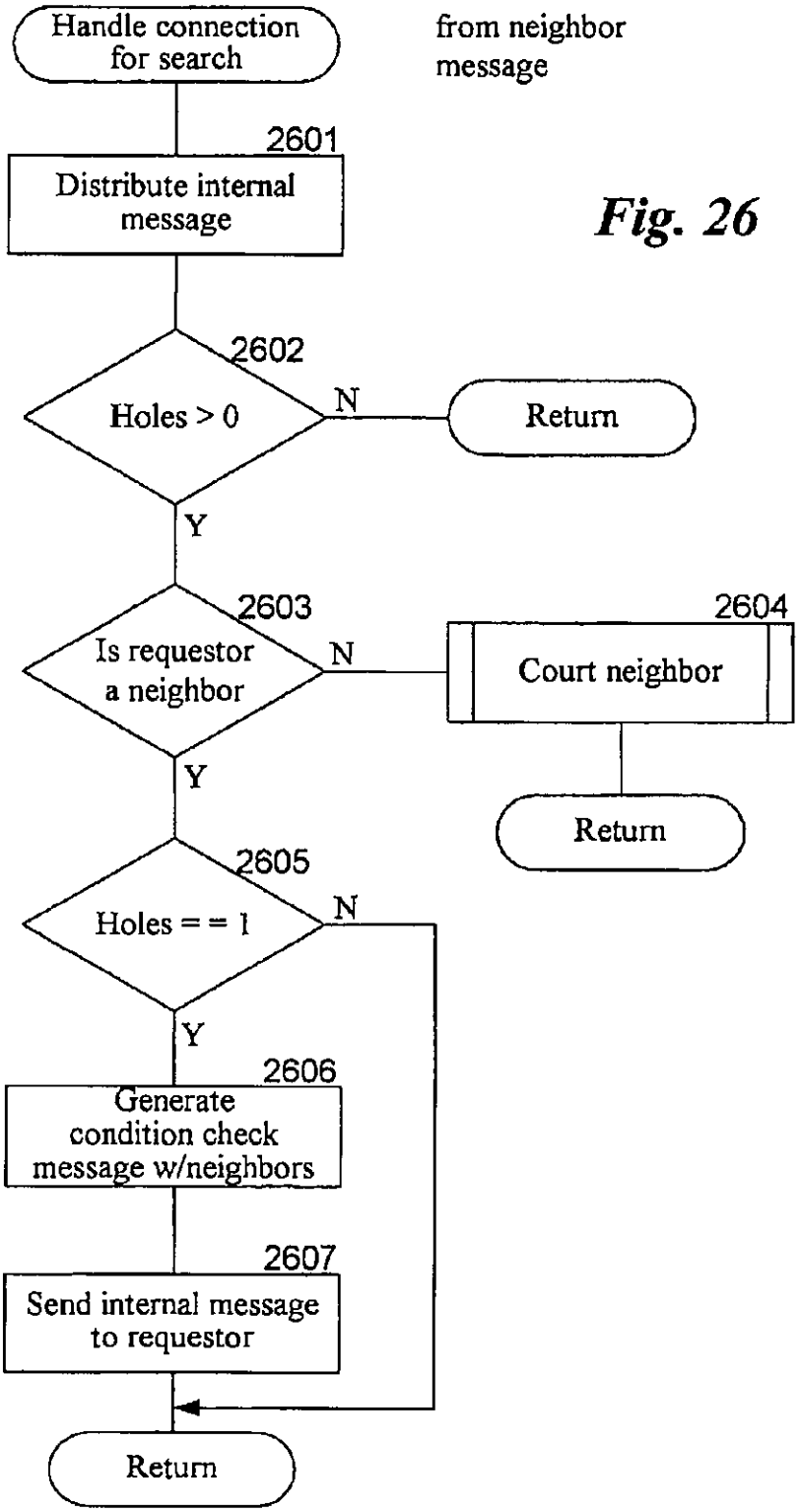


Fig. 26

Fig. 27

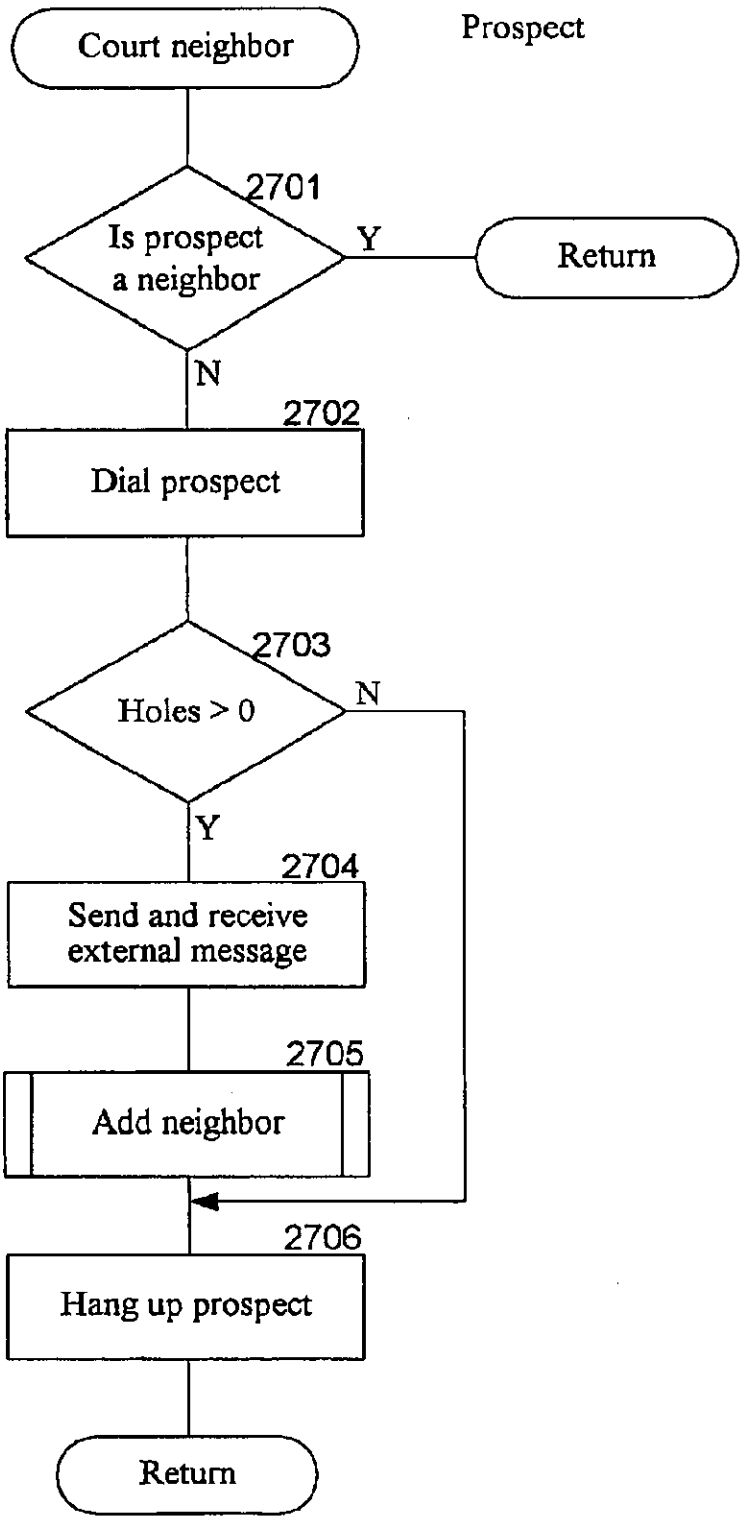


Fig. 28

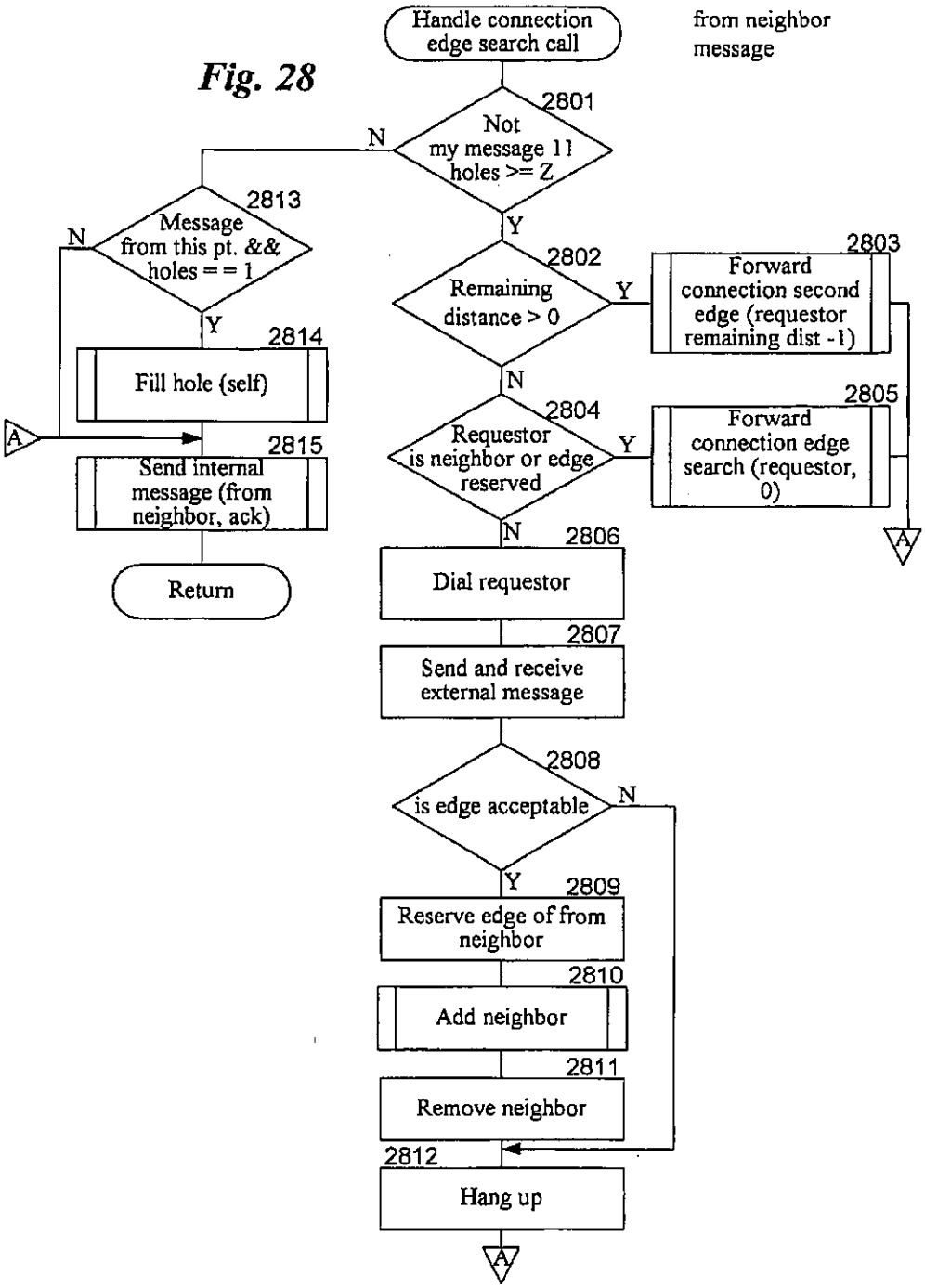


Fig. 29

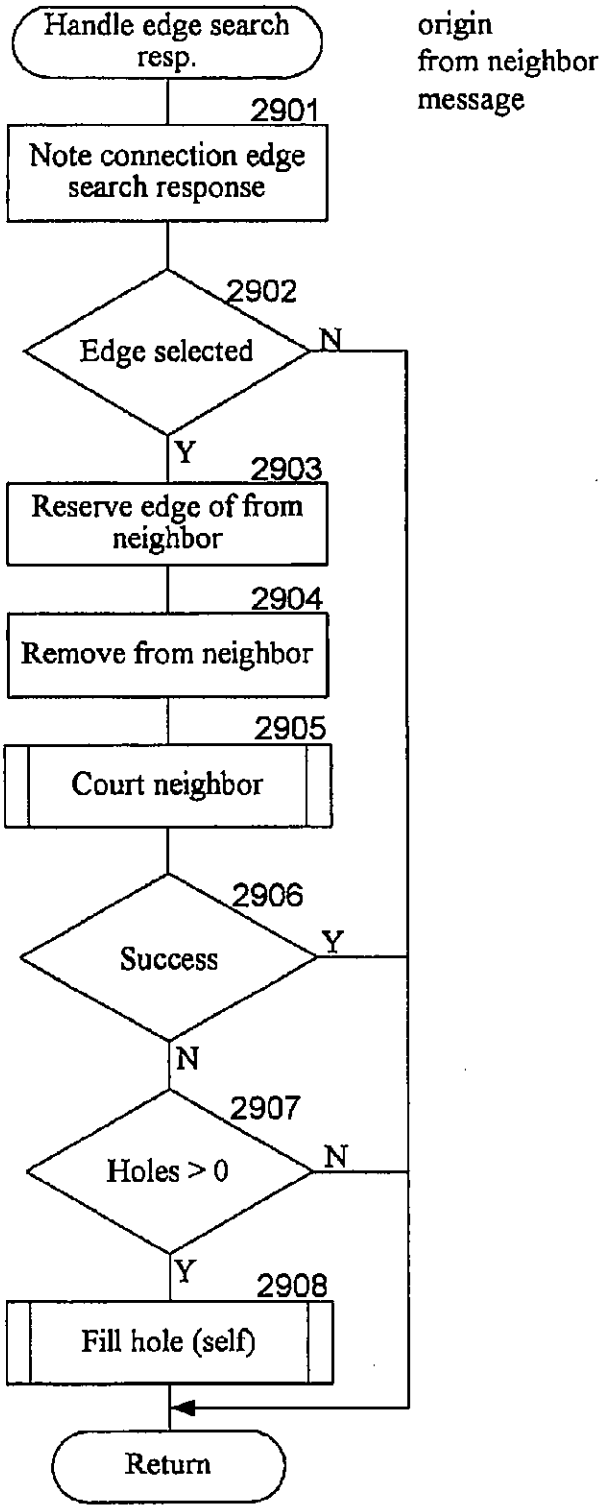


Fig. 30

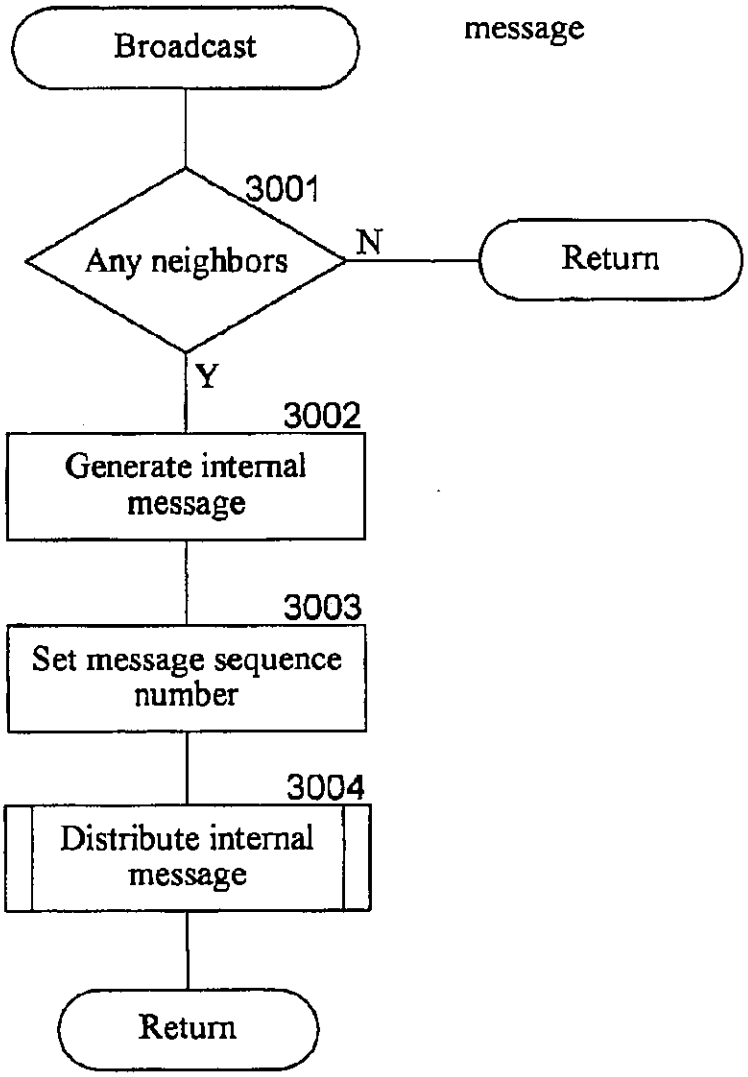


Fig. 31

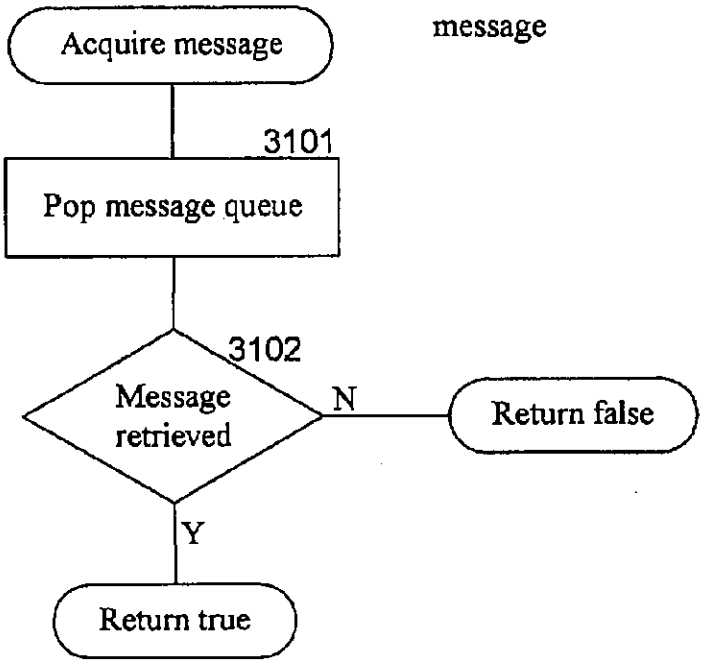


Fig. 32

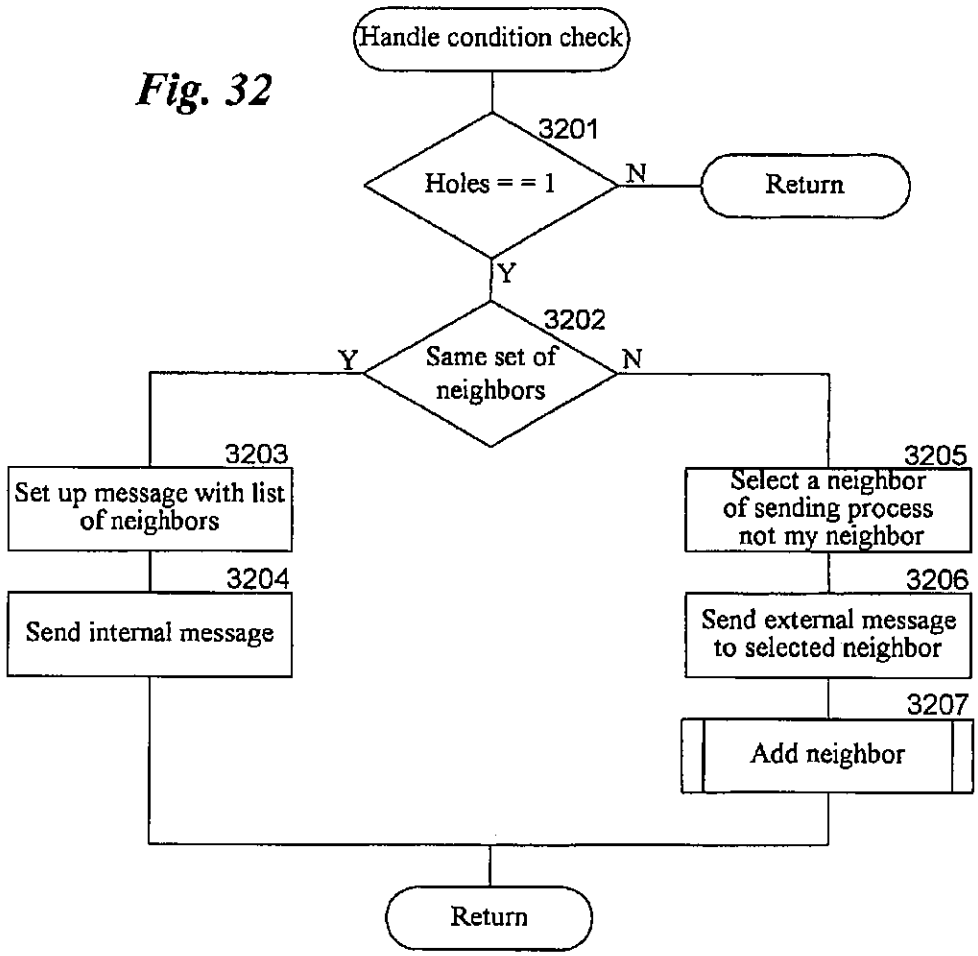
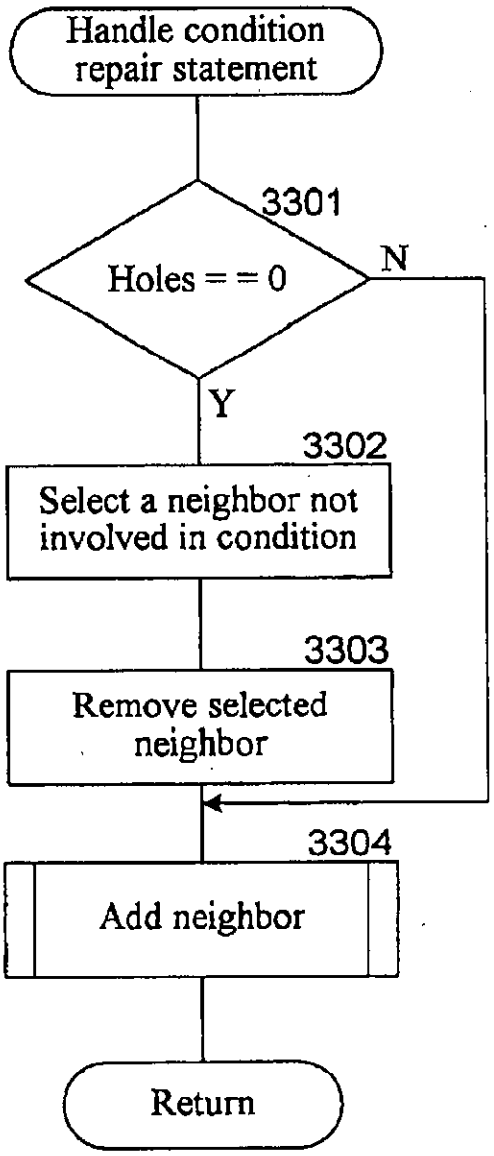


Fig. 33



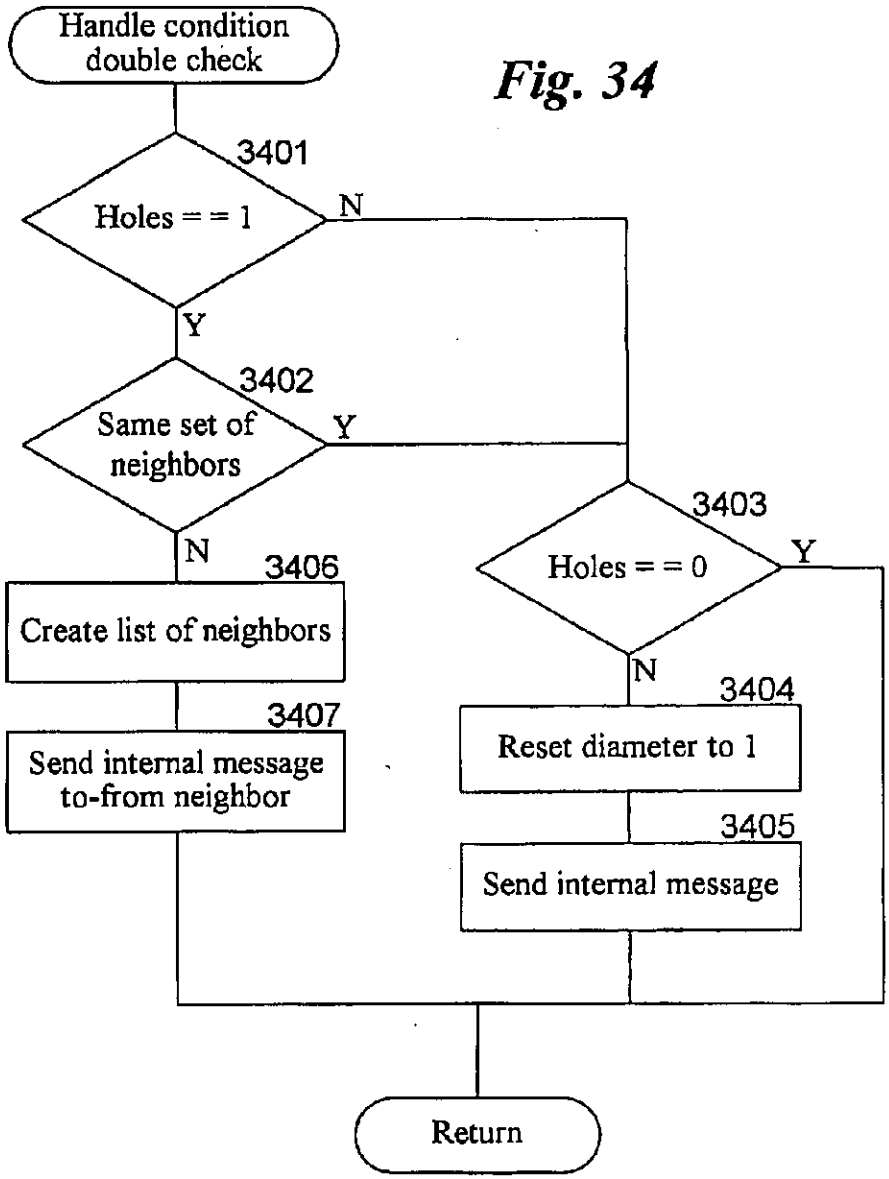


Fig. 34

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 particularly 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.

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.

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

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) tbe broadcasting of messages over the broadcast channel (i.e., broadcasting tbrough 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 witb four of tbe 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 tben connecting to each identified neighbor. Each computer is aware of one or more "portal computers" through which that computer may locate tbe broadcast channel. A seeking computer locates the broadcast channel by contacting the portal computers until it finds one that is currently fully connected to tbe broadcast channel. The found portal computer tben directs tbe 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 tbe 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 tbe 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, tbe broadcast technique identifies two pairs of computers that are currently connected to each other. Each of tbese 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 D are the two pairs that are identified as the neighbors for the new computer Z. The conuections 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 througb 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 tbe 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, wbich 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

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 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

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 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 it 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

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 form 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 is 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 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

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, 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.

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 implement 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 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

-continued

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 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

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.

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 is 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 routiue 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

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 bangs 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 neigbbor. 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 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

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 is 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 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 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**,

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 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 a 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

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 embodiment. 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 neighhors 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.

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.

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

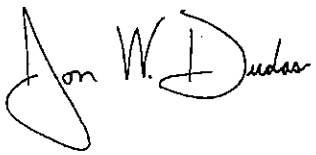
PATENT NO. : 6,732,147 B1
DATED : May 4, 2004
INVENTOR(S) : Fred B. Holt

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



JON W. DUDAS
Acting Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

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

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";

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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.

Case No. IPR2016-00747
Patent 6,732,147

DECLARATION OF MICHAEL GOODRICH, Ph.D. IN SUPPORT OF PATENT OWNER'S RESPONSE TO PETITION

EXHIBIT
5
Bims
2/7/2017 C.A.R.

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*

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

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.

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.

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.

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*.

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.

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 be 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

> topologies. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

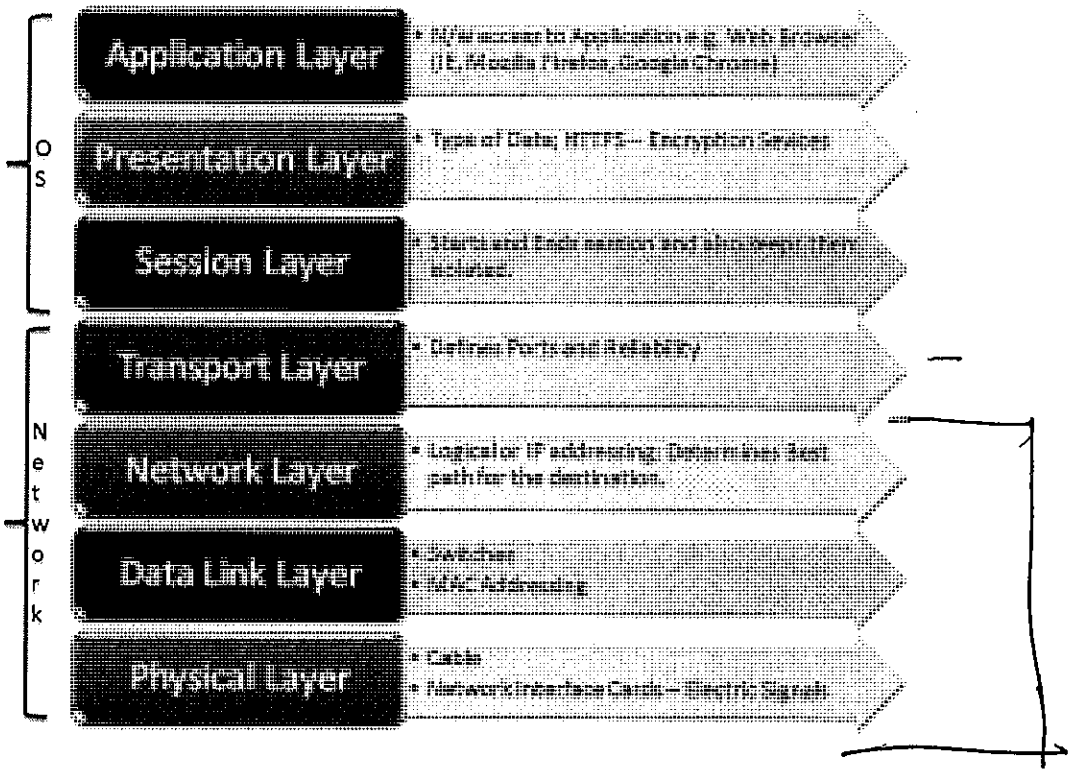
Karger Decl. at ¶ 19.

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:



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.

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

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

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):

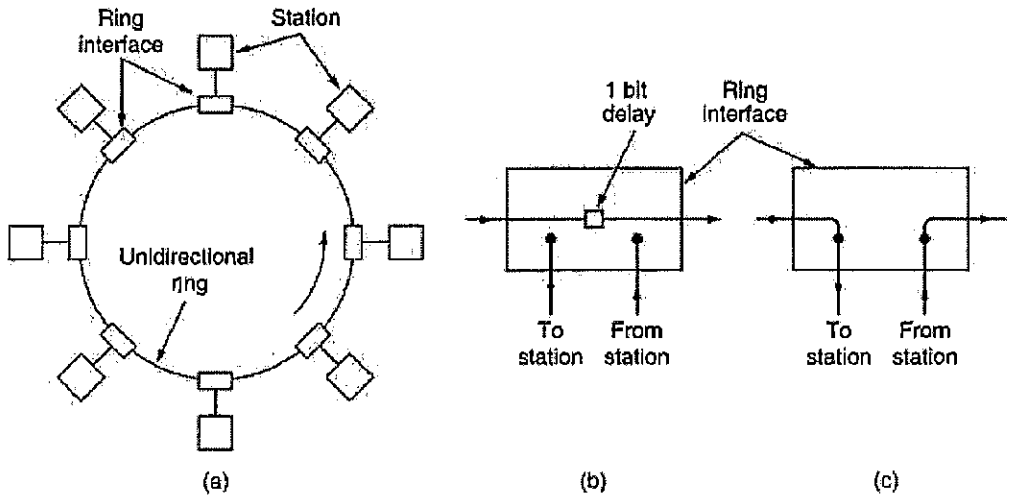


Fig. 4-28. (a) A ring network. (b) Listen mode. (c) Transmit mode.

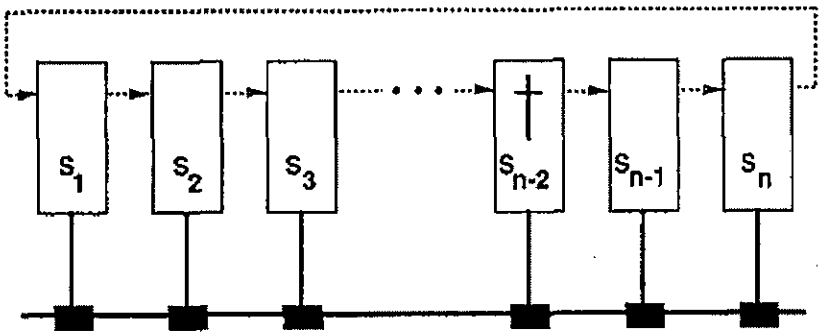
Tanenbaum at 293.

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

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.

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.

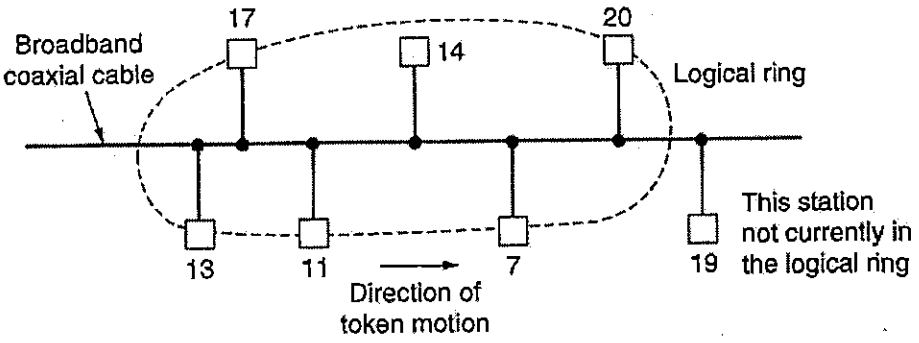


Fig. 4-25. A token bus.

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.

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.

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:

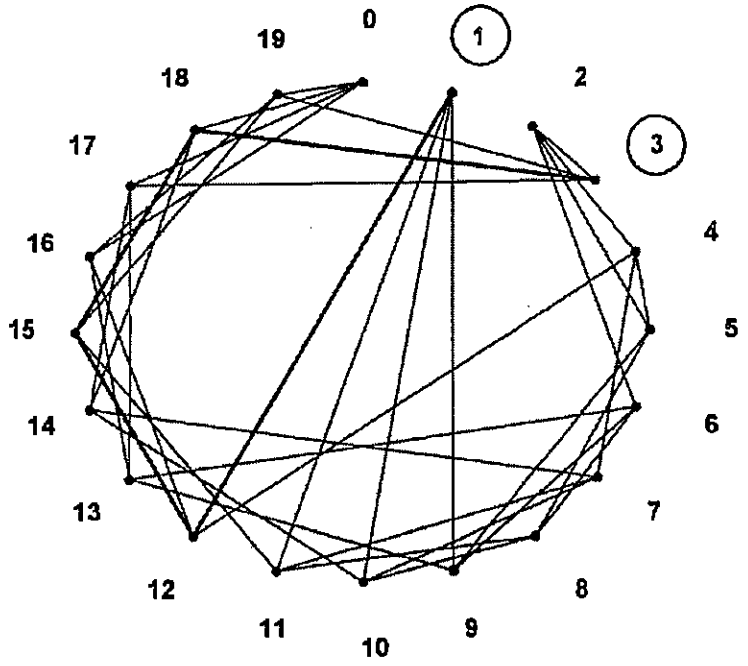


Fig. 2

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

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

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.

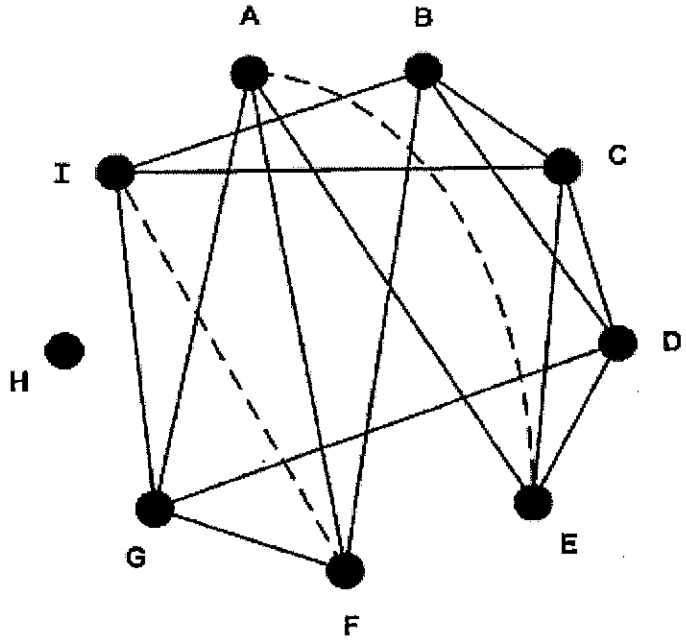


Fig. 5B

'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.

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

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.

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".

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

> 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

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.

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.

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.

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 $\Gamma_{n,k} = (P,E) \in \mathbf{PR}_k$, $p \in P$, and we take the vertex pairs p_1p_2, p_3p_4, ..., $p_{k-1}p_k$ to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be:
>
> (3) $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$
> $E' = E \setminus \{ (pp_1), (pp_2), \ldots, (pp_k) \cup \{ (p_1p_2),(p_3p_4), \ldots,(p_{k-1}p_k) \}$

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

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, …, $p_{k-1}p_k$, 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 $q_1, q_2, \ldots, q_r$ be neighbors of p in Γ_n. Then we take the subgraph of Γ_n generated by p (designate this $G_p = (P', E')$), and it turns out this is the subgraph where $P' = \{q_1, q_2, \ldots, q_r\}$ 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 Γ_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.

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:

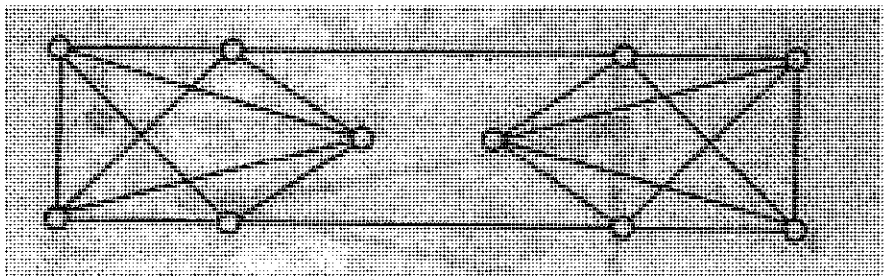


Figure 2

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,

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

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

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:

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[3], 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.

[1]LAN level information packet.
[2]User level information packet.
[3]Manufacturing Automation Protocol.

Rufino at 1, right column (emphasis added0.

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:

> 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

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").

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

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:

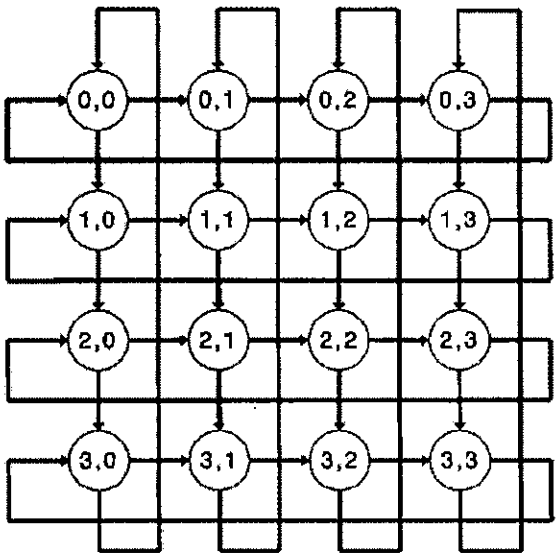


Fig. 1. The token grid (4 × 4 example).

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.

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):

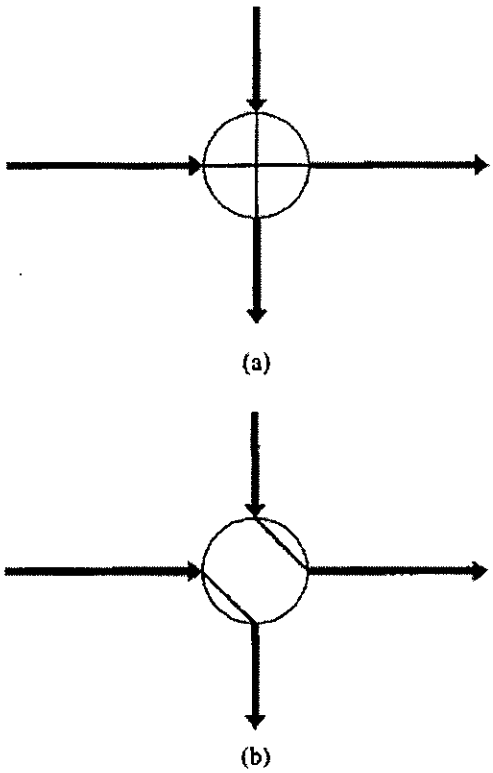


Fig. 2. Station configurations.

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

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

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

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 Γn,k = (P,E) ∈ PRk, p ∈ P, and we take the vertEx. pairs p1p2, p3p4, . . . , pk-1pk to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be: (3) ET-1: Γn,k → Γn-1 = (P', E'), P' = P \ {p}" and "E' = E \ { (pp1), (pp2), . . . , (ppk) ∪ { (p1p2), (p3p4), . . ., (pk-1pk) }"); 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.

> 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

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

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

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

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 "$E' = E \setminus \{ (pp1), (pp2), \ldots, (ppk) \cup \{ (p1p2), (p3p4), \ldots, (pk\text{-}1pk) \}$")." 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, "$\Gamma_{n,k}$," prior to removal. See Denes at 366 ("The ET^{-1}

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).

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

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.

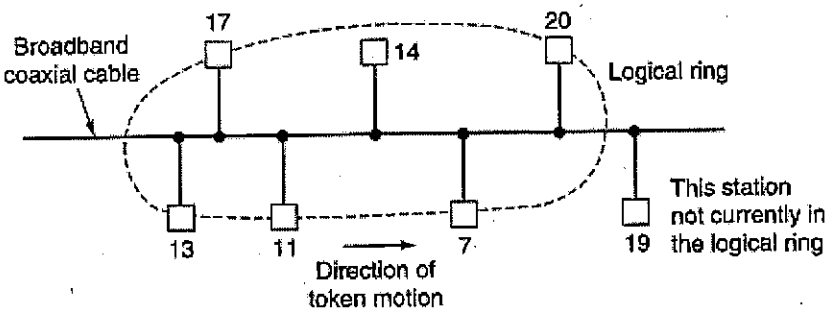


Fig. 4-25. A token bus.

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

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.

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

> 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

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

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.

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 Γn,k = (P,E) ∈ PRk, p ∈ P, and we take the vertEx. pairs p1p2, p3p4, . . . , pk-1pk to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be: (3) ET-1: Γn,k → Γn-1 = (P', E'), P' = P \ {p}" and "E' = E \ { (pp1), (pp2), . . . , (ppk) ∪ { (p1p2),(p3p4), . . ., (pk-1pk) }"); 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

> 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

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.

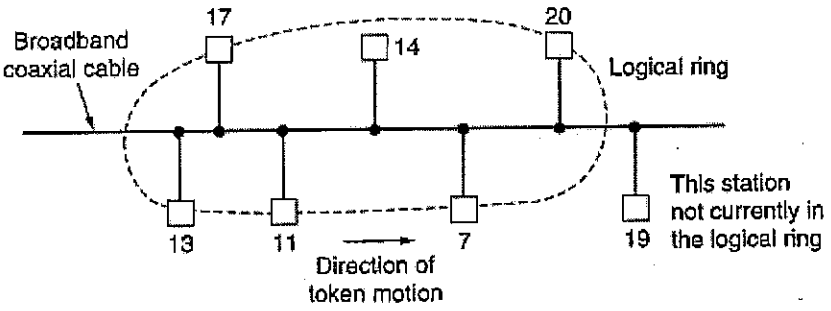


Fig. 4-25. A token bus.

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.

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

> 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

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:

> 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,

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 8802/4sets 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,

> 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 packer 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

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

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

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

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

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.

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:

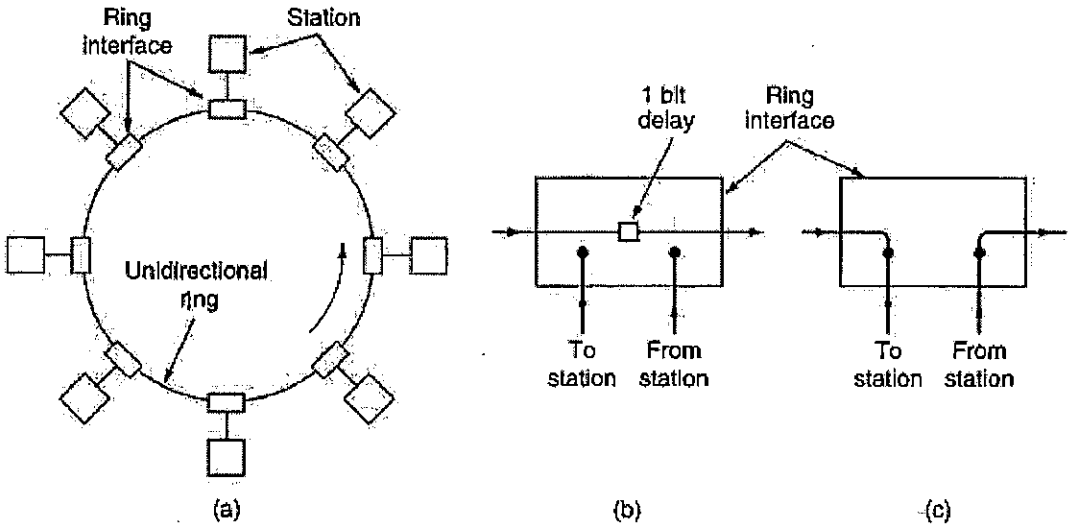


Fig. 4-28. (a) A ring network. (b) Listen mode. (c) Transmit mode.

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

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

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.

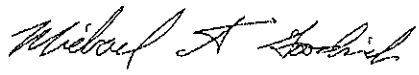
Ex. 2010, Karger Tr., 75:9–18.

152. Accordingly, in my opinion POSITA would not be motivated to combine Shoubridge, Denes, Rufino, and Todd for the reasons stated above.

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.



Michael Goodrich, Ph.D.

APPENDIX A

CURRICULUM VITAE

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EDUCATION

Ph.D.	1987	*Efficient Parallel Techniques for Computational Geometry* 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

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Other Publications:

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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.

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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
Sympoisum 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 Ramaiyer	"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
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Josiah Carlson	UC-Irvine	Advancement to candidacy, August 2006
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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
Abinesh 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
Stragic 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 Belvior, 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 Collabortive 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 Tamssia).
22. PI, "Collaborative Research: Teaching Data Structures to the Millennium Generation," $125,00, 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 Sensitve 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 Sensitve 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

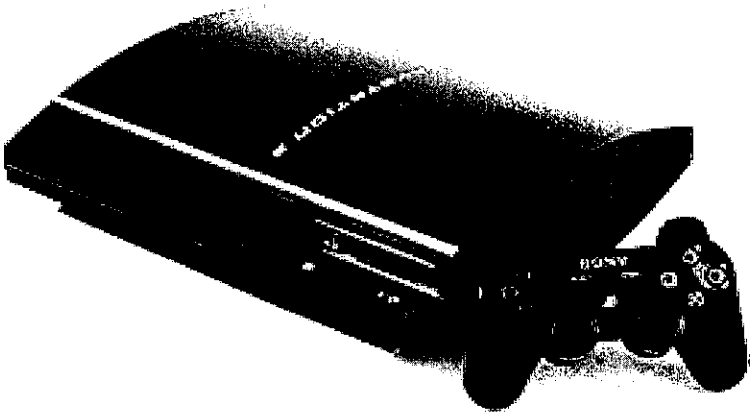
EXHIBIT 6
Bims
2/7/2017 C.A.R.

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 biggest disadvantage of the PS3 is that it currently does not upscale

More stories


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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.

UP NEXT
Snapchat's not just for sexting anymore

Even If you look past the price difference, the arguments for buying a PS3 instead of current Blu-ray players are overwhelming. First, the PS3 is currently the only HDMI 1.3 Blu-ray player on the market. What that means in real terms is that it is the only current Blu-ray player that will be compatible with future HDMI 1.3 receivers that will be able to decode the highest-resolution soundtrack formats: DTS HD Master Audio and Dolby TrueHD. (That pretty much obviates the PS3's dearth of 5.1 analog audio inputs as well.) Another factor is that the PS3 is flat-out the fastest player of the bunch. It skips chapters nearly instantly and loads discs fast, while the others move along at a relatively slow pace. Its advantages as a Blu-ray player aside, don't forget that Blu-ray playback is just a piece of the PS3's functionality. None of the other current Blu-ray players offer high-definition gaming or the extensive media player capabilities of the PS3--both of which will undoubtedly get better with more software and additional firmware upgrades in the months and years ahead.

Don't get me wrong, I'm not advocating that everyone should run out and buy a PS3. In fact, that only new gaming system I own is the Nintendo Wii, and I'm not planning on buying a high-def disc player until the current format war shakes out a little more. Also, don't forget we're just weeks away from the Consumer Electronics Show, where we'll see a full line-up of second-generation Blu-ray players that may very well give the PS3 a run for its money. But if you just absolutely need to own a Blu-ray player now, the PS3 looks to be the best of the bunch.

Share your voice

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Crave | Tech Culture

Up Next: Snapchat's not just for sexting anymore

SORT BY: Newest | Oldest

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That says alot about his
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going for the niche.

Sexting and Brexit: Things we

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
@richardjnieva

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.

going for the niche.

yawn.

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Here's another one of Snapchat's trademarks: It's confusing. It's got a funky design, probably on purpose, like a user interface secret handshake. (In fact, that's listed as a risk factor.)

But the app itself may not be the only thing confusing to you. Maybe you're not sure what all the fuss is about. We scoured the 178-page IPO filing and picked out some tidbits to bring you up to speed:

Who is Snap? This is how they describe themselves: "Snap Inc. is a camera company. We believe that reinventing the camera represents our greatest opportunity to improve the way that people live and communicate...In the way that the flashing cursor became the starting point for most products on desktop computers, we believe that the camera screen will be the starting point for most products on smartphones. This is because images created by smartphone cameras contain more context and richer information than other forms of input like text entered on a keyboard."

The money. Snap is valued at $20 billion to $25 billion. It's looking to raise $3 billion in the offering.

The man. Evan Spiegel, Snap's cofounder, owns about 22 percent of the company. When it goes public, he'll get another 3 percent of the stock. His annual salary starting in October was $500,000, but it will now go down to $1. He'll get a $1 million bonus each year (based on parameters he and the board agree on), and Spiegel's stock holdings make him a billionaire many times over.

"Delete by Default." That appears to be the company's new mantra. Snap explains that once smartphones -- and smartphone cameras -- became popular, photos themselves became less important to save. "When images became so easy to take and share with smartphones, it became easier to use images for communication," Snap said.

gettyImages-510337680.jpg

Spiegel is engaged to supermodel Miranda Kerr.
Steve Granitz/WireImage

SNAP. It's going to trade on the New York Stock Exchange under the ticker symbol SNAP.

Not profitable -- ever? Snap has never turned a profit since beginning commercial operations in 2011. As of December 31, it had an accumulated deficit of $1.2 billion. The company warns it expects future operating losses, and "may never achieve or maintain profitability." To sum up: It's never made any money and maybe never will.

The board. Michael Lynton, one of Snap's earliest investors and the CEO of Sony Entertainment, is the board's chairman. He announced last month he's leaving Sony to work at Snap full time. Of all the company's non-employee directors, only one of them is a woman. That's Joanna Coles, chief content officer of Hearst Magazines. She's also appeared as a mentor on "Project Runway." Make it work.

Picaboo. Snapchat began life in 2011 as Picaboo, an iPhone photo messaging app.

Sexting. As in, that's what Snap was known for in its early days. But the company says even then, "we knew it was being used for so much more. We think this was because deletion by default was an unusual concept compared to what was standard at the time, so it took time for people to understand that we were trying to solve a problem that many people didn't realize they had."

Young'uns. Most Snapchat users are 18 to 34 years old, but it's people younger than 25 who spend the most time on the app. On average, users 25 and older visited Snapchat about 12 times and spent about 20 minutes a day. Meanwhile, users under 25 visited Snapchat over 20 times and spent over 30 minutes on the app each day.

Snapchat short videos or images -- 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 basis).

UP NEXT
Tech companies newest cause celebre?

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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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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EXHIBIT
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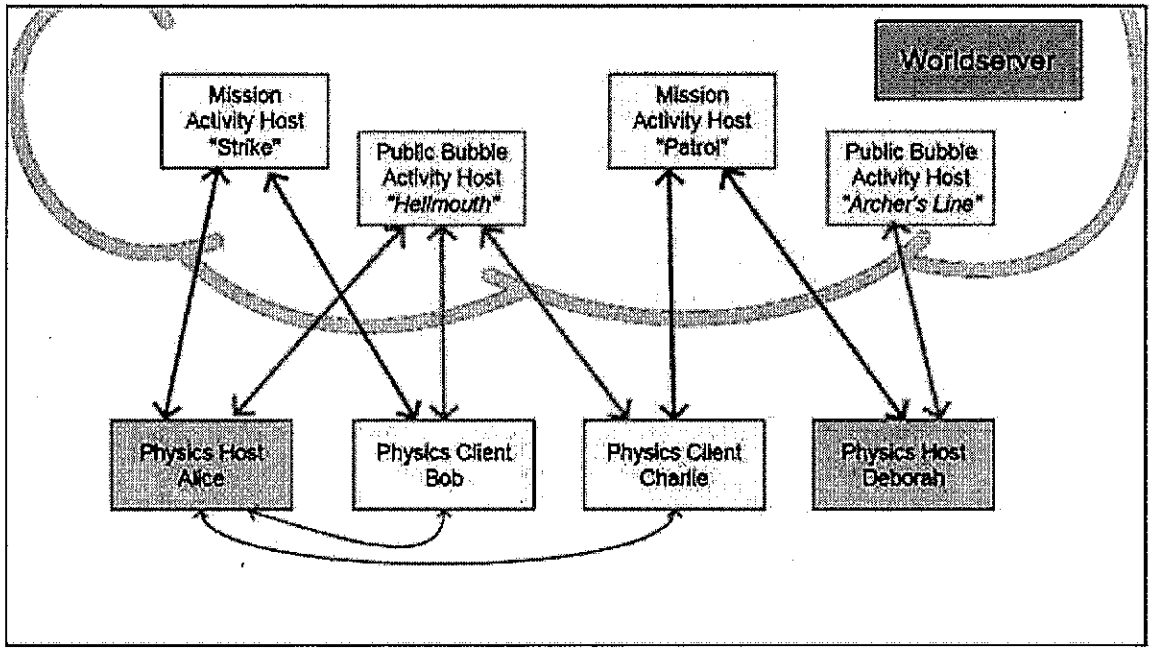
Bims
2/7/2017 C.A.R.

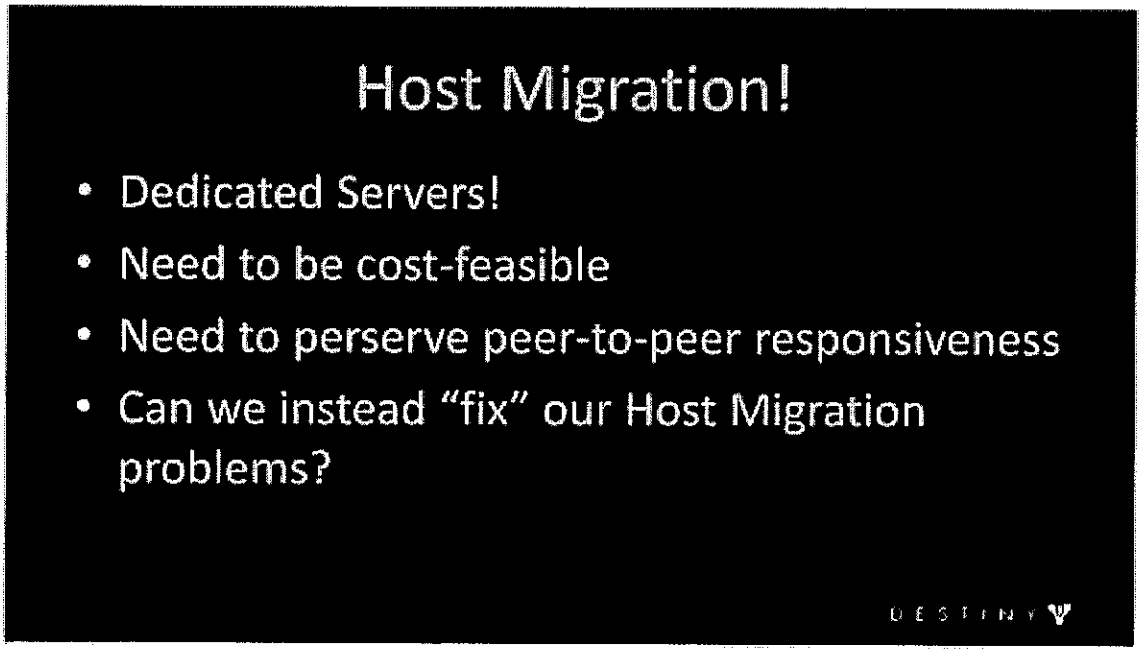
6,732,147	Sony PlayStation Product
"**Sony PlayStation Product**" refers to the PlayStation 3, PlayStation 4 running, for example, the PlayStation game Destiny.	
Claim 6	
claim 6(a): A method for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3, the method comprising:	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. 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: • manage states when different players leave, are kicked, or are disconnected. • manage the game during gameplay and to relay content through different NAT configurations; • route game data using optimal paths and relays; • distribute VoIP chat data among the players; and • determine which game a player should be matched to; • ensure no players are overloaded for optimal gameplay in a connectivity mesh; • create a game session with logical and physical network topologies • connect players to other players for matchmaking; 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)



... and uniquely complicated networking topology

Exhibit 2029 (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 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:



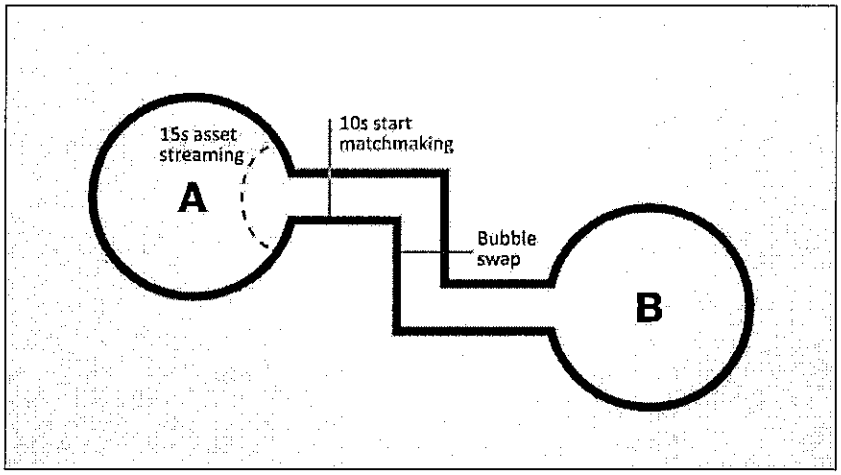
At this point, I'm sure some of you are thinking – just use dedicated servers! If we just never Host Migrate, because we put all our Physics Hosts in the cloud, we never have to solve all these pesky problems.

There's a couple strong reasons we didn't simply run dedicate 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.

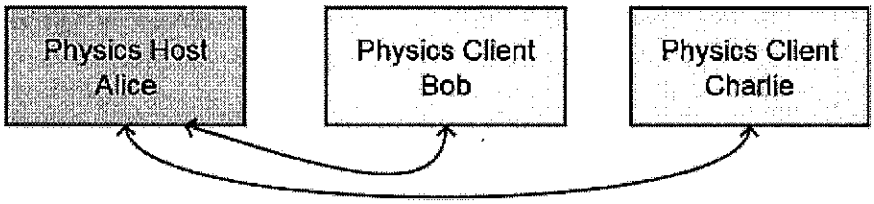
Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 53.

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) 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.

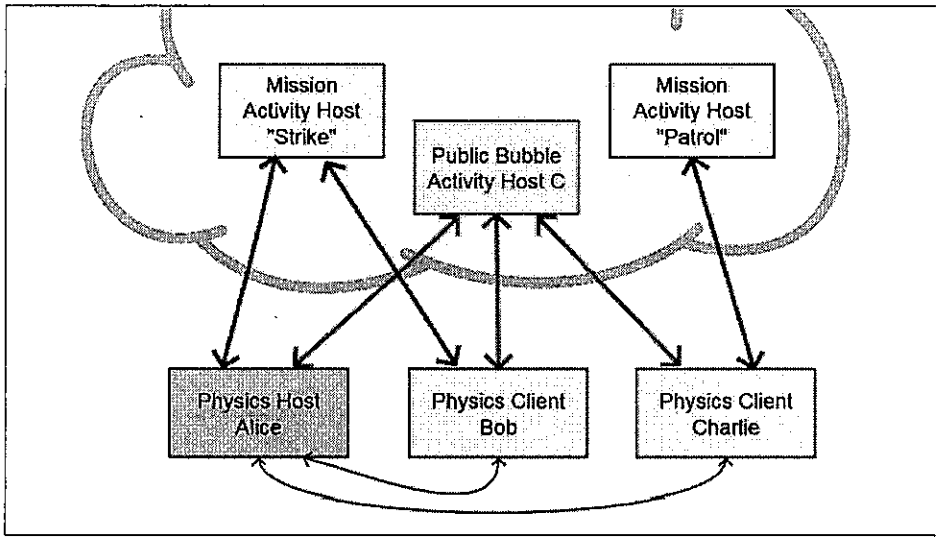
Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf at 96.

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) 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/o1/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:

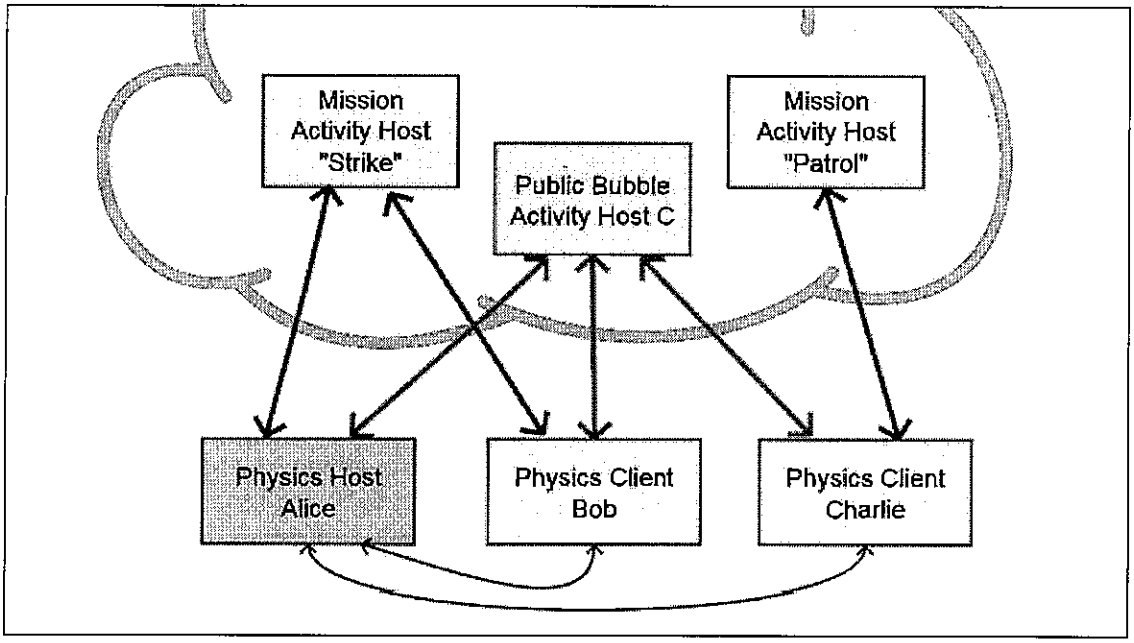
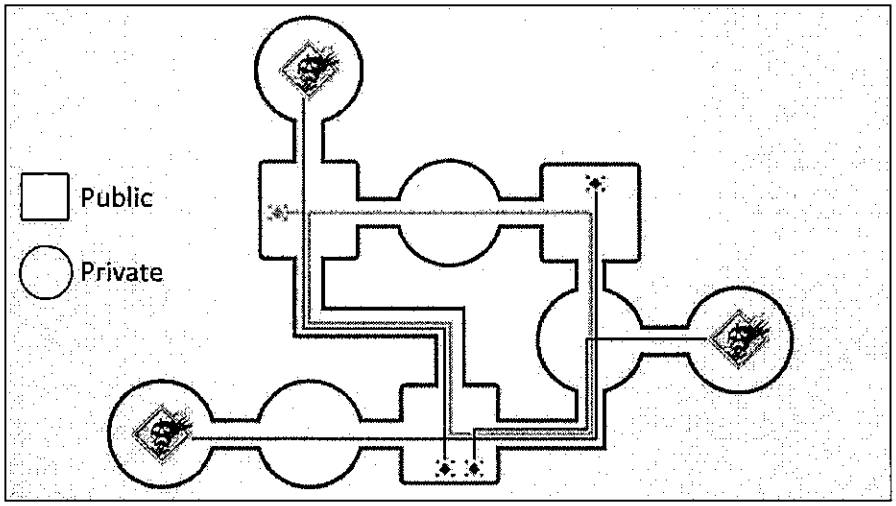


Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 99.

Exhibit 2037 (https://www.youtube.com/watch?v=nIDyPPxKotM&feature=iv&src_vid=XKQfiwPzjmc&annotation_id=annotation_2453463955)

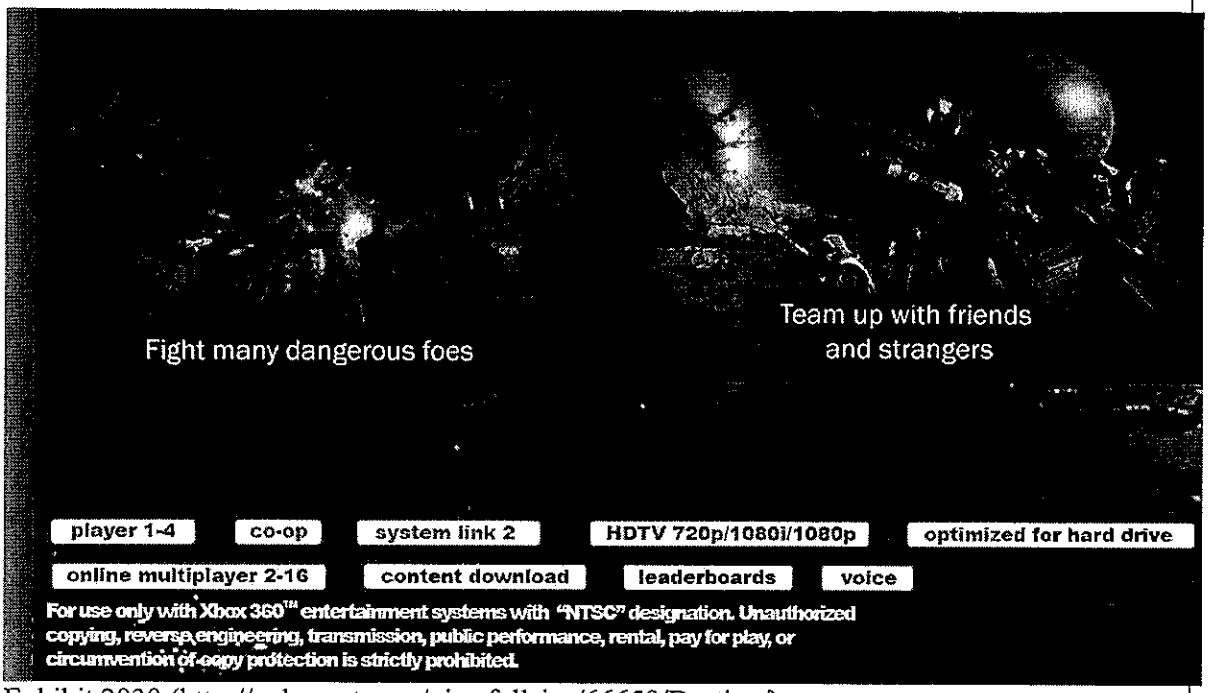
Exhibit 2037 (https://www.youtube.com/watch?v=mfzIDQQLCqk).

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) at 51; *see also* Exhibit 2029 (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:

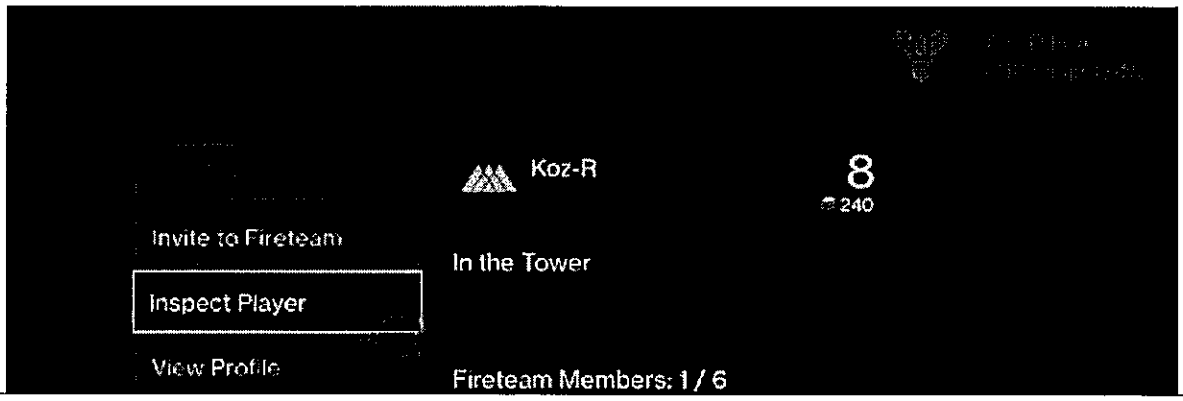
Exhibit 2033 https://www.youtube.com/watch?v=dPcrmT0of5g

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



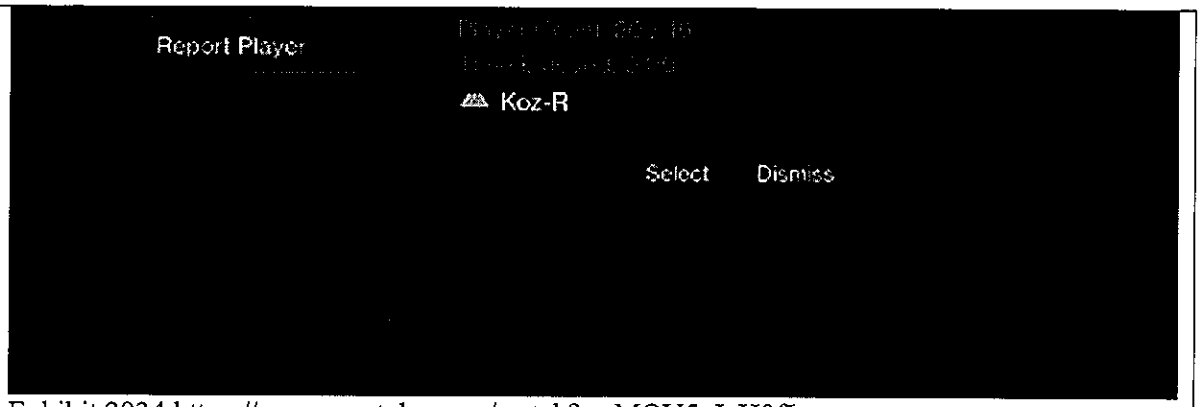


Exhibit 2034 https://www.youtube.com/watch?v=MOY5zJcH0fI

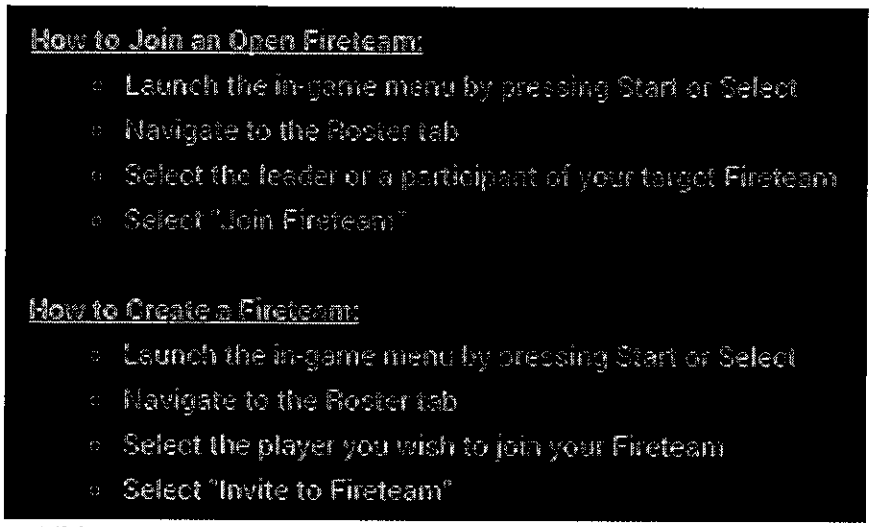


Exhibit 2024 https://www.bungie.net/7_How-to-Join-or-Create-a-Fireteam/en/Help/Article/13978

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

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:

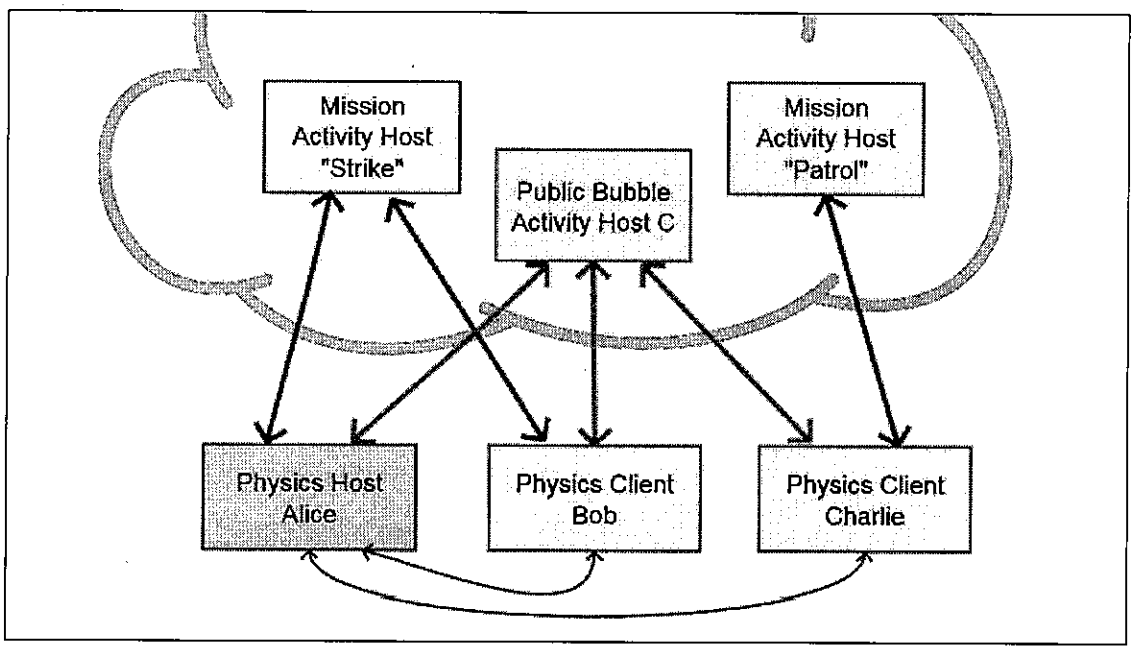
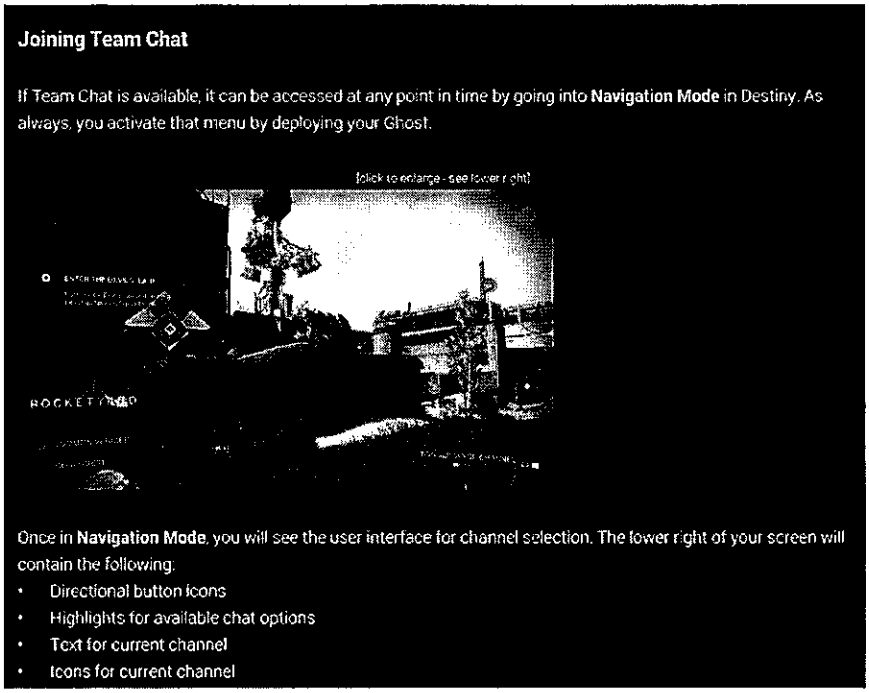


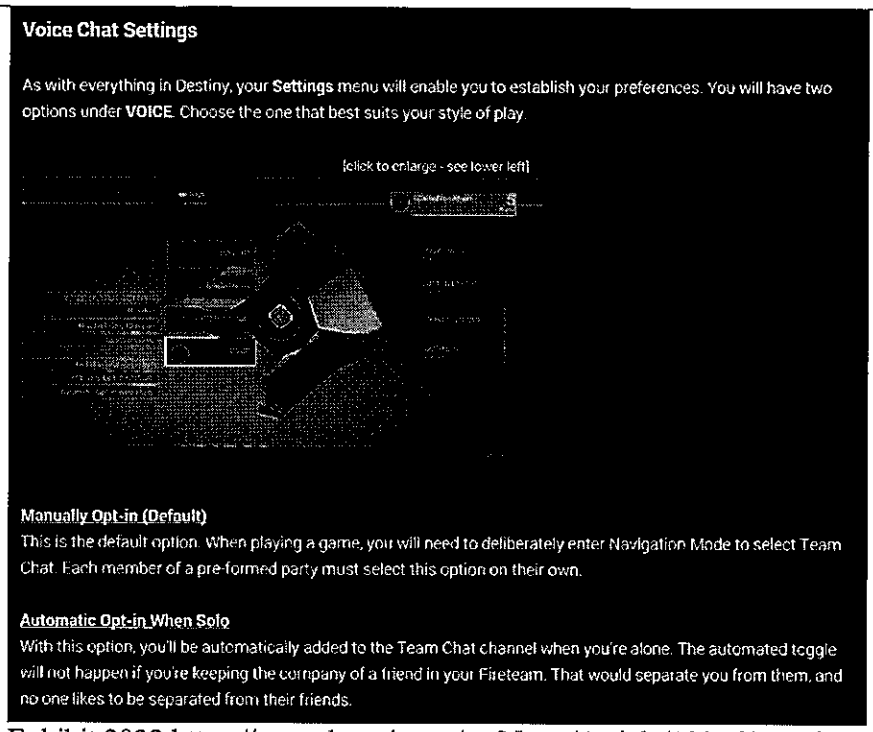
Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 99

Exhibit 2037
https://www.youtube.com/watch?v=nIDyPPxKotM&feature=iv&src_vid=XKQfiwPzjmc&annotation_id=annotation_2453463955

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:

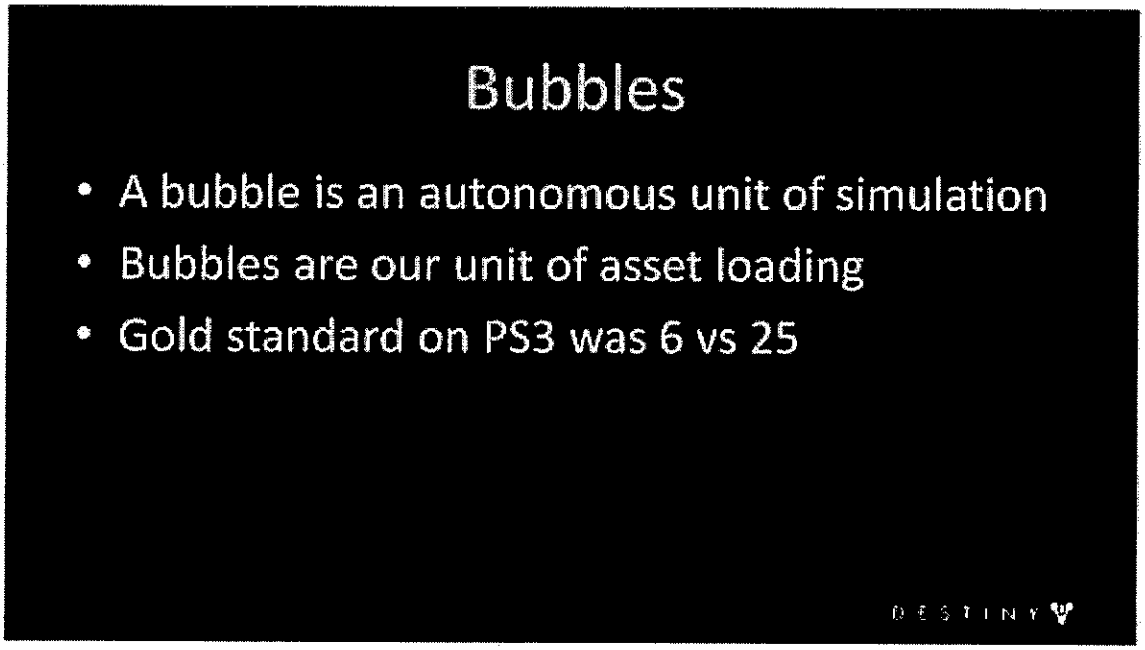


	 Exhibit 2032 https://www.bungie.net/en/News/Article/12376/7_voice-chat-beta-in-destiny
claim 6(c): when the attempt to send the message is unsuccessful, broadcasting from the first computer a connection port search message indicating that the first computer needs a connection; and	The Sony PlayStation 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. 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:

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) at 49;

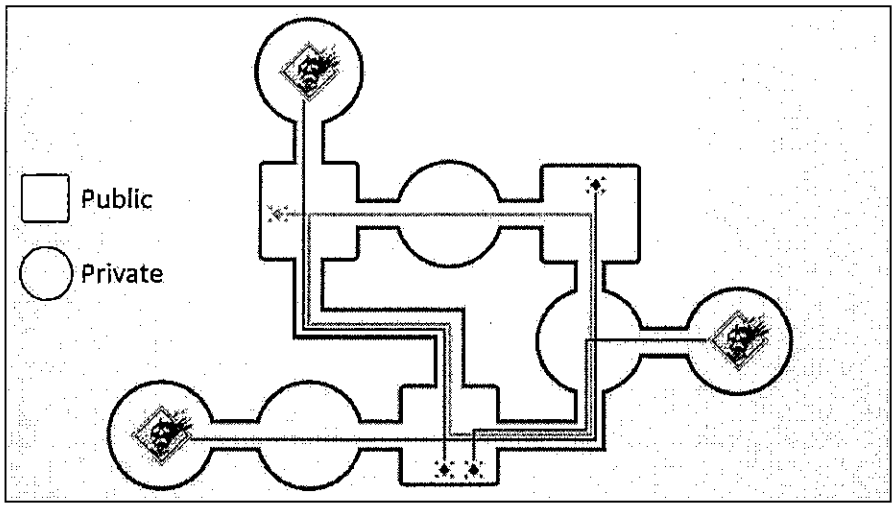


A bubble is our unit of simulation – a player is only ever simulating a single bubble's worth of combat and physics at any time.
A bubble is also our unit of asset streaming – you have at most 2 bubble's asset memory loaded at any time – the one you're currently simulating, and the one you're precaching.

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) 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.

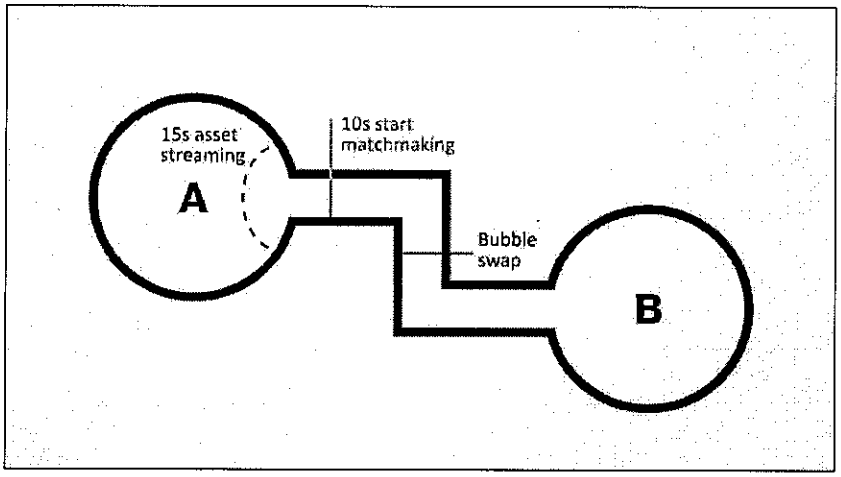
Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 51; *see also* Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 40.

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) at 11; see also Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 17 ("We force you to matchmake 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.

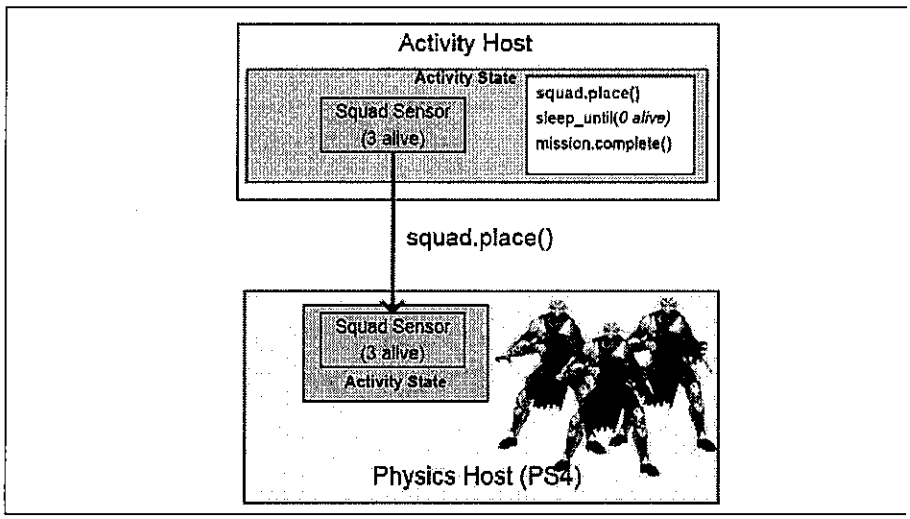
Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 36.

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) 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:



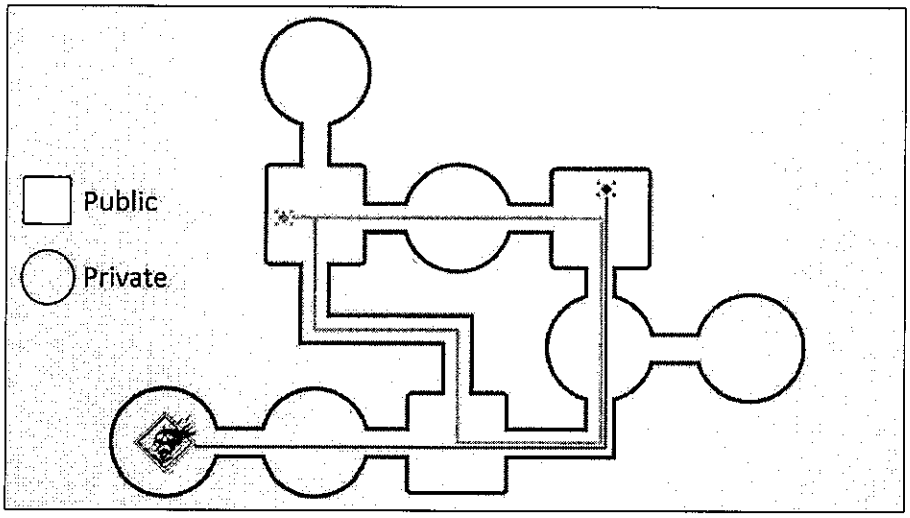
At this point the 3 AI are simulated on the Physics Host, and P2P networked to other clients.

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) at 80.



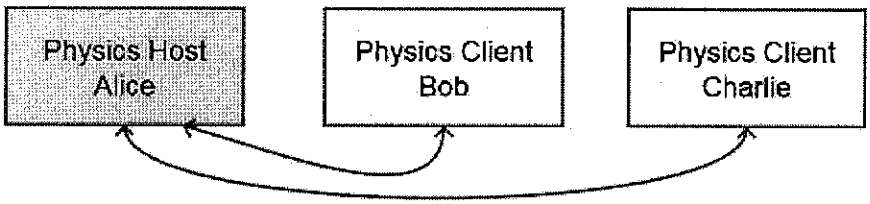
Now if I add some other activity lines – most of our activities start in a public bubble, and they all take you on a deliberate path through many bubbles. You typically get some exposure to 1-2 public bubbles during an activity line, and then dive into a private-bubble chain where we can have a hand-authored mission climax.

Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 45; see also Exhibit 2029 (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").

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) 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 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) 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:

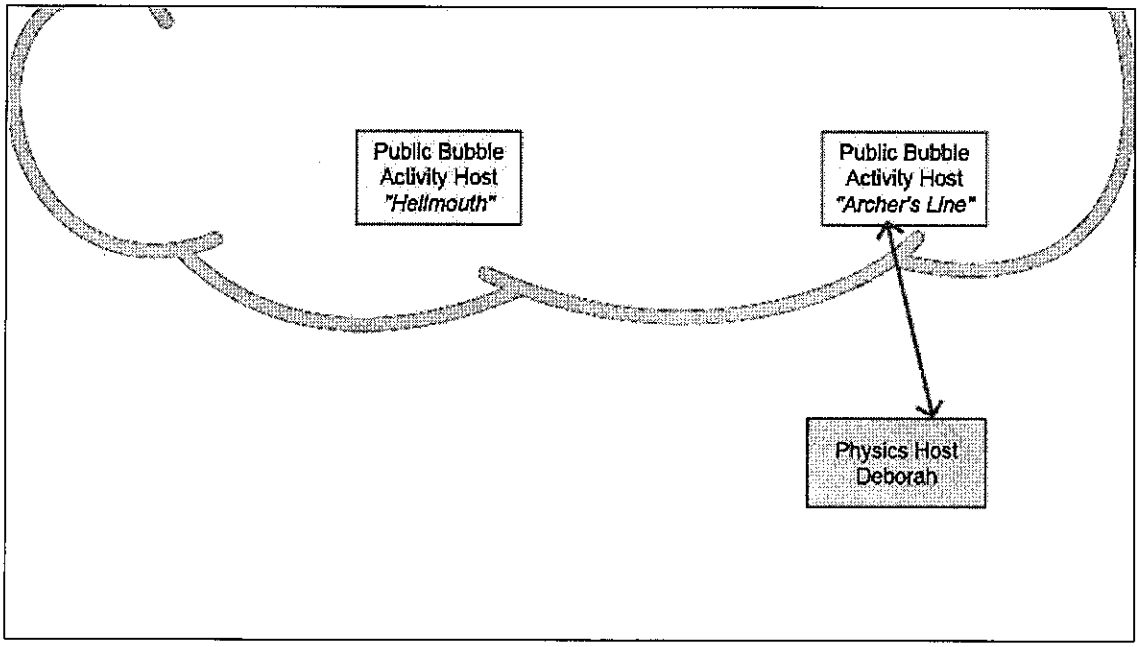


Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 125.

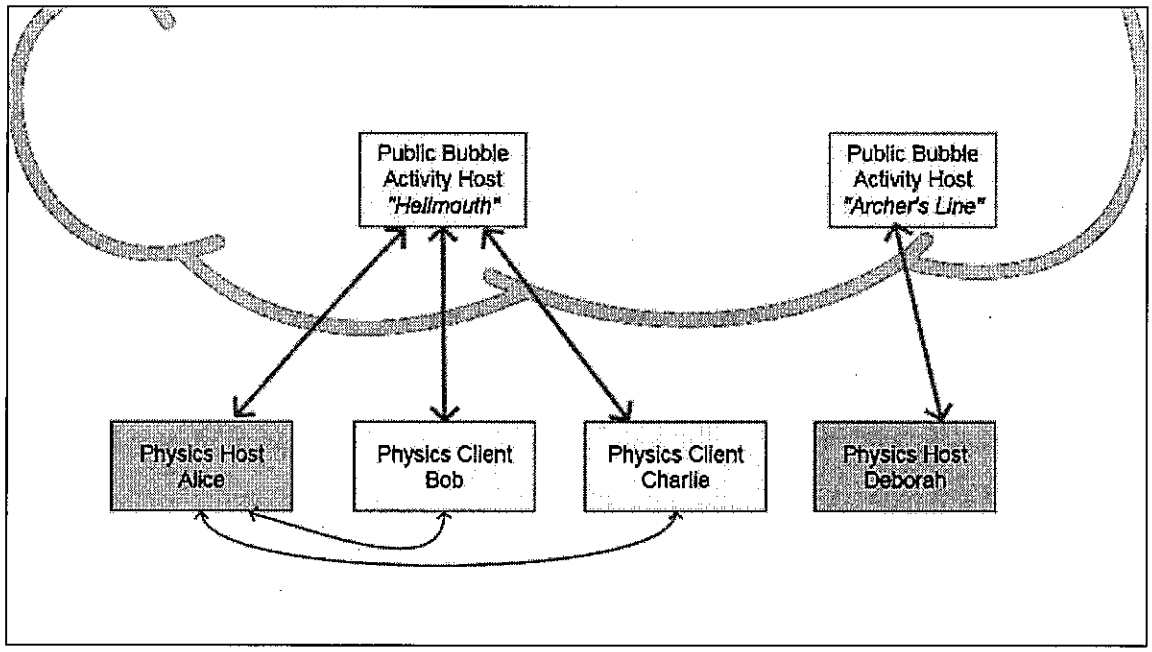


Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 126.

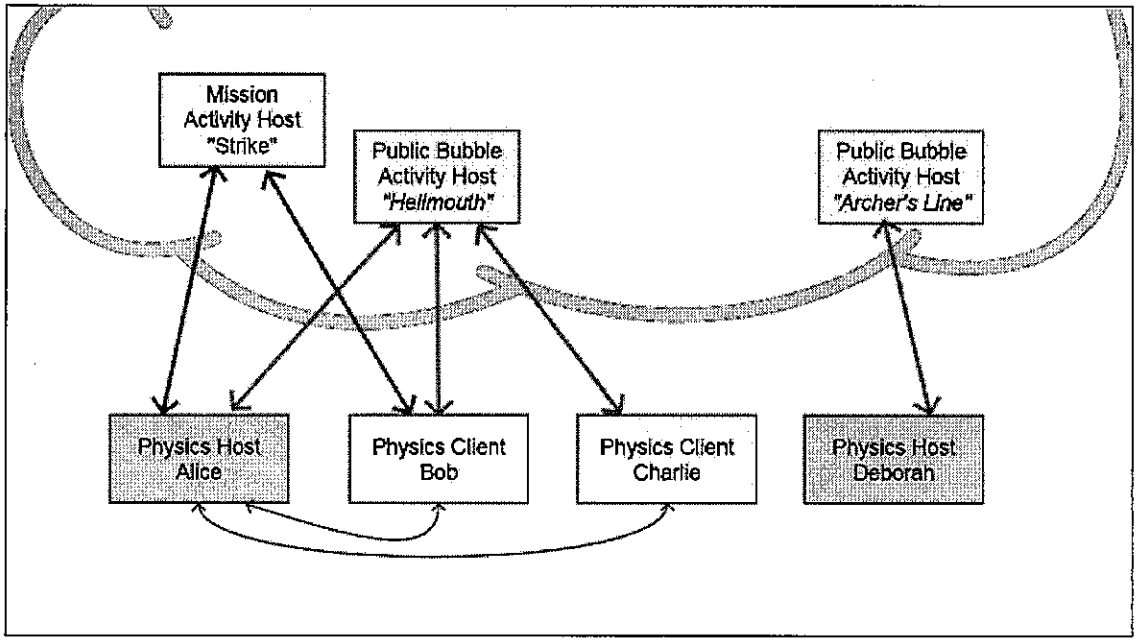


Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 127.

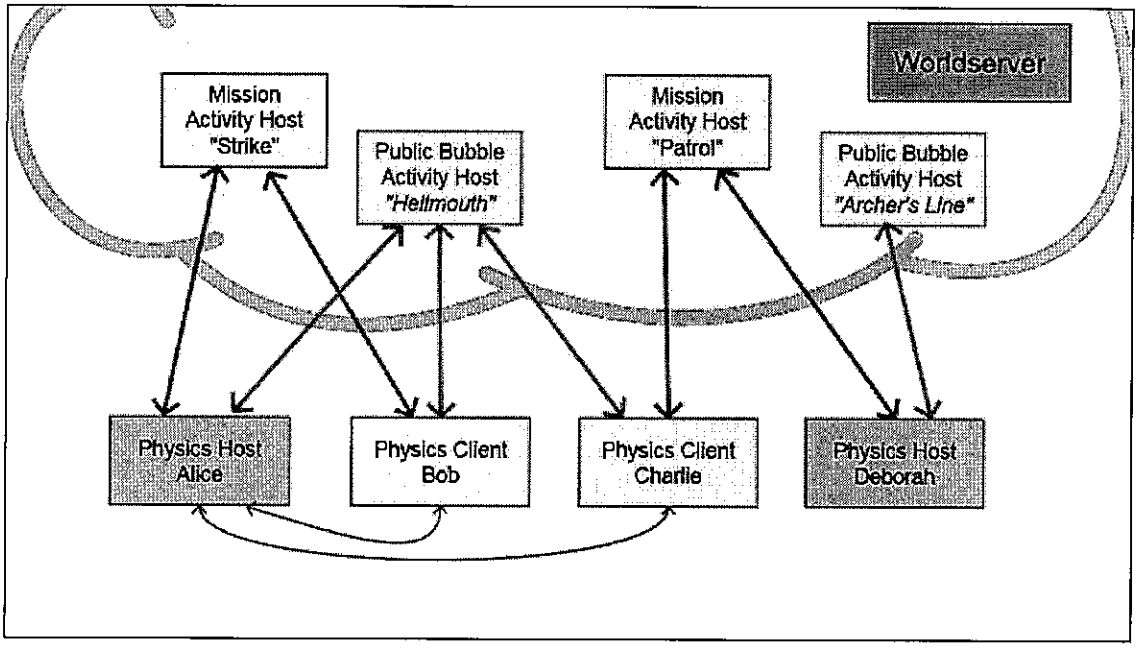


Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 132

So, to reiterate:

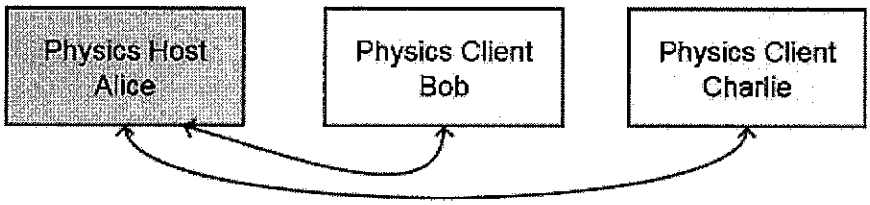
Each Fireteam gets their own Mission Host. All fireteammates are always connected to the same mission host (and this may be the only connection they share, if they're not in the same bubbles)

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) 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) 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:

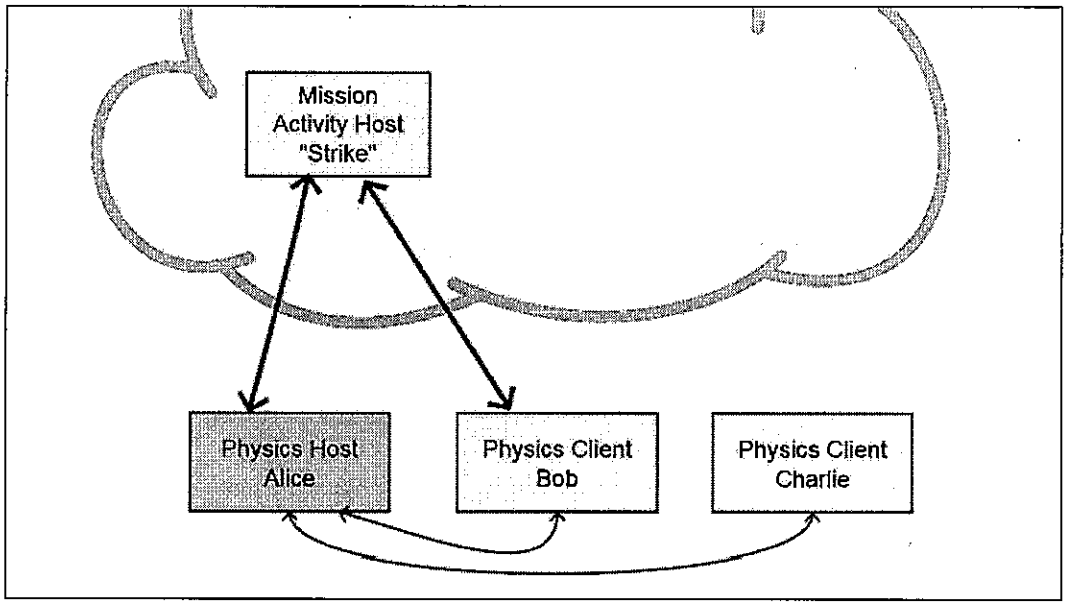


Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 97.

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:

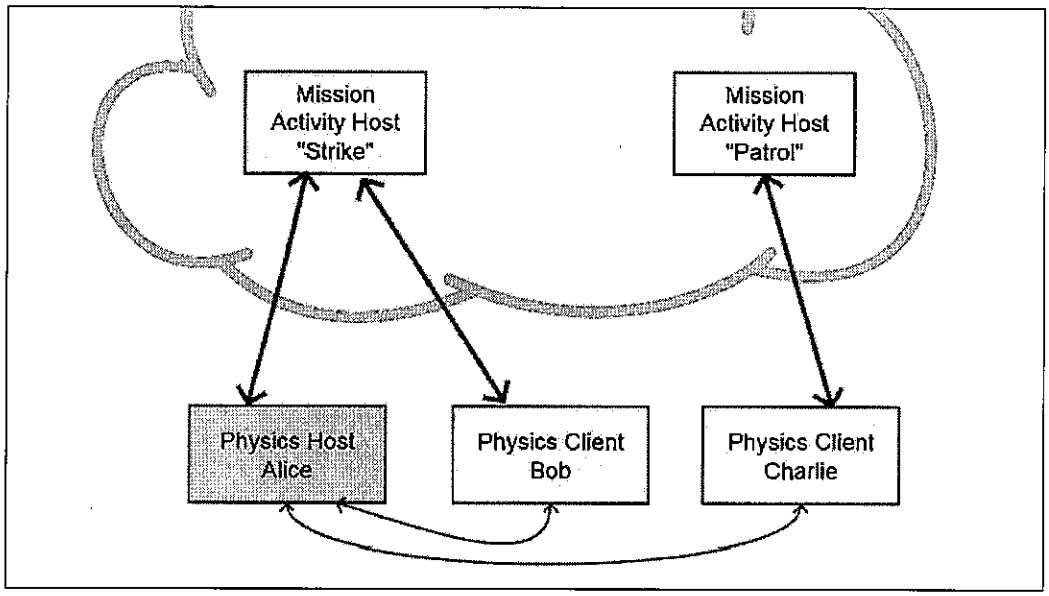


Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 98.

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:

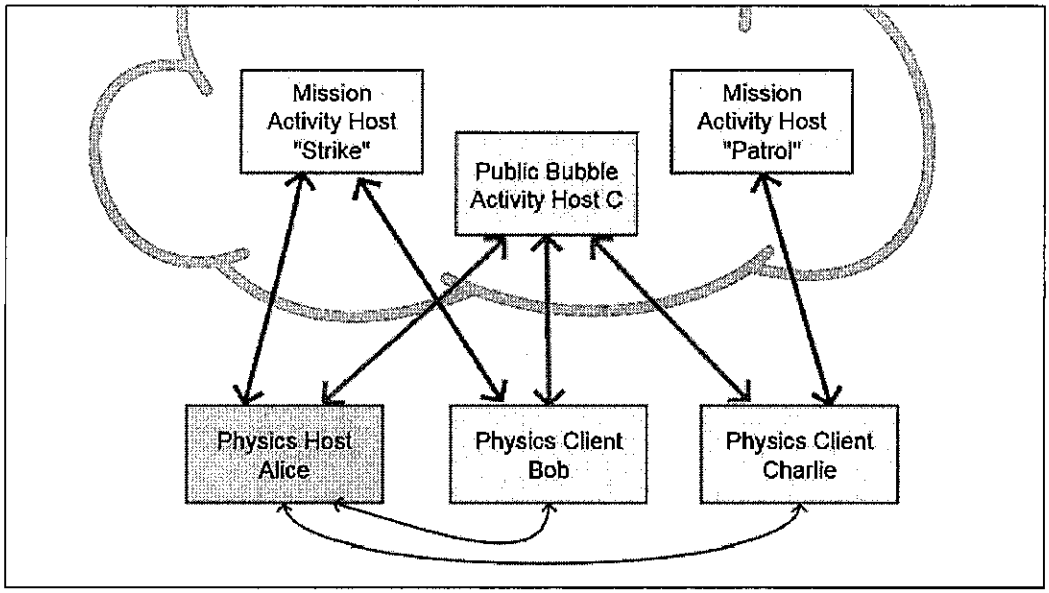


Exhibit 2029 (http://twvideo01.ubm-us.net/o1/vault/gdc2015/presentations/Truman_Justin_Shared_World_Shooter.pdf) at 99

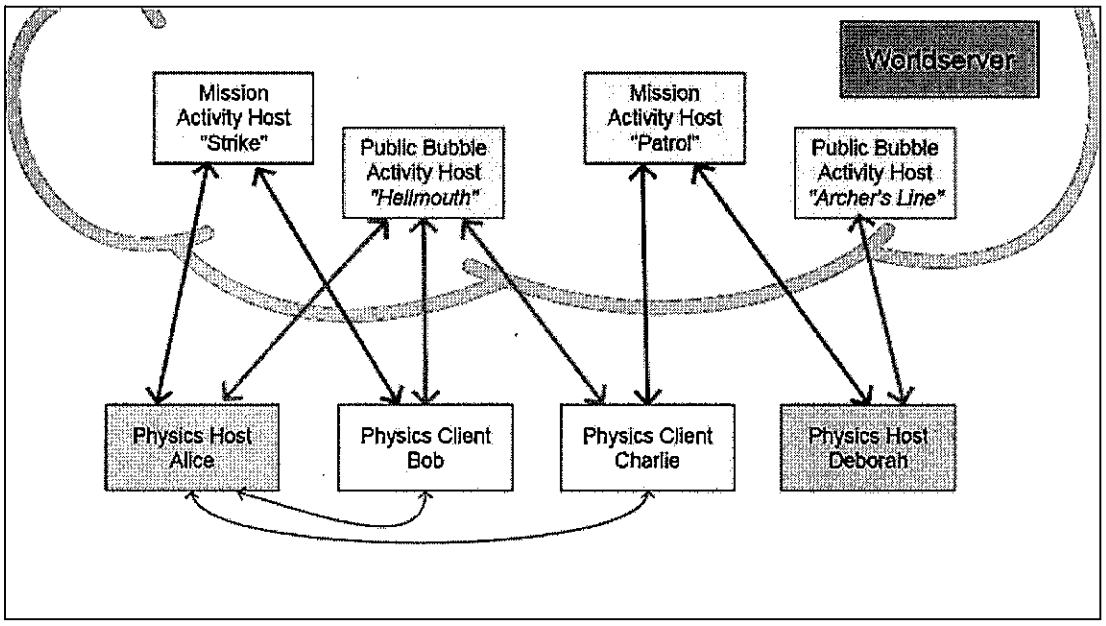


Exhibit 2029 (http://twvideo01.ubm-

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:

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) 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	How your PS4™ system is connected to the Internet 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. Type 1: The system is connected directly to the Internet. Type 2: The system is connected to the Internet with a router. Type 3: The system is connected to the Internet with a router.

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) 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 ("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")

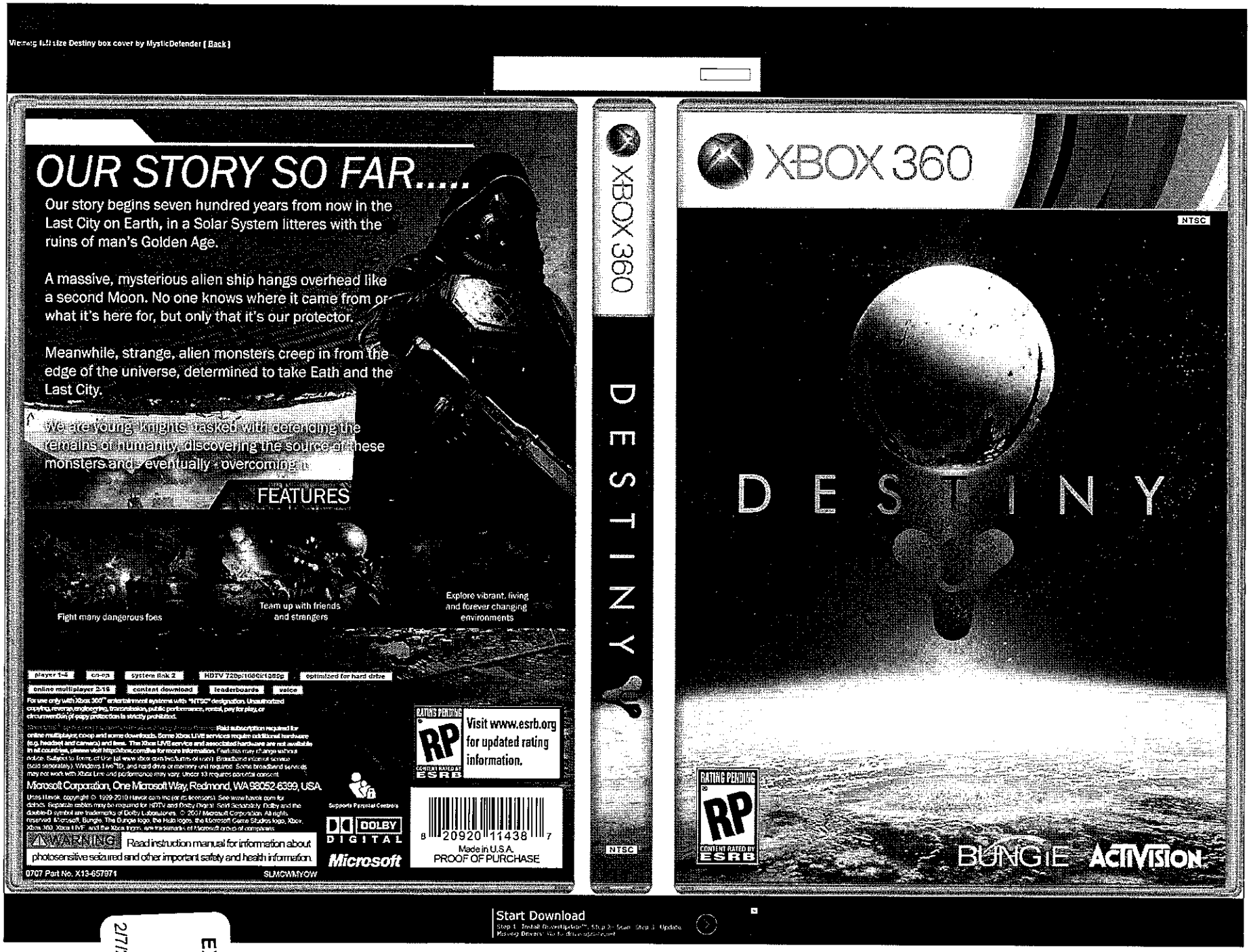


EXHIBIT 8 Bims 2/7/2017 C.A.R.