

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

**[CORRECTED] PETITION FOR *INTER PARTES* REVIEW OF
UNITED STATES PATENT NO. 6,732,147**

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LIST OF EXHIBITS

Exhibit	Description
Ex. 1001	U.S. Patent No. 6,732,147 (“the ’147 patent”)
Ex. 1002	U.S. Patent No. 6,732,147 File History
Ex. 1003	Expert Declaration of David R. Karger (“Karger”)
Ex. 1004	Declaration of Scott Bennett, Ph.D
Ex. 1005	Peter J. Shoubridge & Arek Dadej, “Hybrid Routing in Dynamic Networks,” IEEE International Conference on Communications, Montreal, 1997 (“Shoubridge”)
Ex. 1006	Declaration of Steven Silvio Pietrobon attaching as Exhibit F Peter J. Shoubridge, “Adaptive Strategies for Routing in Dynamic Networks” (Ph.D. Thesis, University of South Australia, December 1996) (“Shoubridge Thesis”)
Ex. 1007	John M. McQuillan, <i>et al.</i> , “The New Routing Algorithm for the ARPANET,” IEEE Transactions Comms., Vol. 28, No. 5, 1980 (“McQuillan”)
Ex. 1008	Yogen Kantilal Dalal, “Broadcast Protocols in Packet Switched Computer Networks,” (Ph.D. Thesis, Stanford University 1977) (“Dalal”)
Ex. 1009	Katia Obraczka, <i>et al.</i> , “A Tool for Massively Replicating Internet Archives: Design, Implementation, and Experience,” Proceedings of the 16th International Conference on Distributed Computing Systems, 27-30 May 1996, Hong Kong (New York, NY: 1996), 657-664 (“Obraczka Paper”)
Ex. 1010	Katia Obraczka, “Massively Replicating Services In Wide-Area Internetworks,” (Ph.D. Thesis, University of Southern California December 1994) (“Obraczka”)
Ex. 1011	Jose Rufino, <i>et al.</i> , “A Study On The Inaccessibility Characteristics Of ISO 8802/4 Token-Bus LANs,” IEEE INFOCOM ’92: The Conference on Computer Communications. One World through Communications. Eleventh Annual Joint Conference of the IEEE Computer and Communication Societies, Florence, Italy, Vol. 2 (Picataway, NJ: IEEE Service Center, 1992), 0958-0967 (“Rufino”)
Ex. 1012	U.S. Patent No. 6,829,634 (“the ’634 patent”)
Ex. 1013	Kuo-Jui Raymond Lin, “Routing and Broadcasting in Two-dimensional Linear Congruential Graphs of Degree Four,” (Master’s Thesis, Concordia University, June 1994) (“Kuo-Jui Lin”)
Ex. 1014	William S. Davis and David C. Yen, <u>The Information System Consultant’s Handbook: Systems Analysis and Design</u> , CRC Press, 1998 (“Davis”)

Exhibit	Description
Ex. 1015	Topological Design Considerations in Computer Communication Networks, Computer Communication Networks (V.G. Cerf, D.D. Cown, R.C. Mullin), 1975 (“Cerf”)
Ex. 1016	Stephen M. Grimes certification of English translation attaching English translation and original text of Tamás Dénes, “The ‘Evolution’ of Regular Graphs of Even Order by their Verticies,” Matematikai Lapok, 27, 3-4 (1976/1979): 365-377 (“Denes”)
Ex. 1017	English language translation from Exhibit 1016: Tamás Dénes, “The ‘Evolution’ of Regular Graphs of Even Order by their Verticies,” Matematikai Lapok, 27, 3-4 (1976/1979): 365-377 (“Denes”)
Ex. 1018	S. Toida, “Construction of Quartic Graphs,” Journal of Combinatorial Theory, Series B, 16.2 (April 1974): 124-133 (“Toida”)
Ex. 1019	T. Todd, “The Token Grid Network,” IEEE/ACM Transactions On Networking, 2.3 (June 1994): 279-287 (“Todd”)
Ex. 1020	Declaration of Peter John Shoubridge and, as Exhibit A, Peter J. Shoubridge, Adaptive Strategies for Routing in Dynamic Networks, Ph.D. Thesis (Univ. S. Austl., 1996) (“Shoubridge Thesis”), and as Exhibit B, Peter J. Shoubridge & Arek Dadej, Hybrid Routing in Dynamic Networks, in 3 IEEE INT’L CONF. ON COMMC’NS CONF. REC. 1381-86 (Montreal, 1997) (“Shoubridge”).
Ex. 1021	U.S. Patent No. 5,802,285 to Hirviniemi (“Hirviniemi”)
Ex. 1022	U.S. Patent No. 4,700,185 to Balph (“Balph”)
Ex. 1023	U.S. Patent No. 6,603,742 to Steele <i>et al.</i> (“Steele”)
Ex. 1024	U.S. Patent No. 6,732,147 File History Excerpt: November 5, 2003 Office Action
Ex. 1025	U.S. Patent No. 6,732,147 File History Excerpt: December 17, 2003 Amendment and Response
Ex. 1026	U.S. Patent No. 6,732,147 File History Excerpt: January 23, 2004 Notice of Allowance
Ex. 1027	L.G. Valiant, “Optimality of a Two-Phase Strategy for Routing in Interconnection Networks,” IEEE Transactions on Computers, C-32.9 (September 1983): 861-863 (“Valiant”)
Ex. 1028	U.S. Patent No. 6,490,247 to Gilbert <i>et al.</i> (“Gilbert”)
Ex. 1029	U.S. Patent No. 6,122,277 to Garmire <i>et al.</i> (“Garmire”)
Ex. 1030	U.S. Patent No. 5,181,017 to Frey <i>et al.</i> (“Frey”)
Ex. 1031	J. Van Leeuwen, <i>et al.</i> , “Interval Routing,” The Computer Journal, 30.4 (August 1987): 298-307 (“Van Leeuwen”).
<i>Ex. 1032-1100: Not Used</i>	

Exhibit	Description
Ex. 1101	U.S. Patent No. 6,910,069 (“the ’069 patent”)
Ex. 1102	U.S. Patent No. 6,910,069 File History
Ex. 1103	U.S. Patent No. 6,910,069 File History Excerpt: May 17, 2004 Amendment

Pursuant to 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42, the undersigned, on behalf of and representing Activision Blizzard, Inc., Electronic Arts Inc., Take-Two Interactive Software, Inc., 2K Sports, Inc., and Rockstar Games, Inc. (collectively, “Petitioners”), hereby petition for *inter partes* review of claims 1-16 of U.S. Patent No. 6,732,147 (“the ’147 patent”). The ’147 patent was issued to The Boeing Company and is purportedly assigned to Acceleration Bay LLC (“ABLLC”). Petitioners assert there is a reasonable likelihood that at least one claim is unpatentable and respectfully request review of, and judgment against, claims 1-16 (“the Challenged ’147 Claims”) as unpatentable under 35 U.S.C. § 103.

I. INTRODUCTION

The ’147 patent relates to “[a] method for leaving a multicast computer network,” i.e., removing a computer from a network. Ex. 1001 at Abstract. The ’147 patent claims a particular technique for removing the computer that features having the leaving computer send a disconnect message to a second computer to which it is connected. The second computer then broadcasts a connection search message across the network to locate another computer in the network to which the second computer can connect. This exact technique is disclosed in the prior art, as explained below. The features that were emphasized by applicant to obtain allowance relate to straightforward networking and graph theory concepts that are also shown by the references discussed below, which were not before the examiner dur-

ing prosecution. Thus, as shown in this Petition, claims 1-16 of the '147 patent were not patentable because the technology claimed was obvious over the prior art.

II. MANDATORY NOTICES UNDER § 42.8

The Real Parties in Interest Under § 42.8(b)(1) are Activision Blizzard, Inc.; Blizzard Entertainment, Inc.; Activision Publishing, Inc.; Activision Entertainment Holdings, Inc.; Electronic Arts Inc.; Take-Two Interactive Software, Inc.; 2K Games, Inc.; 2K Sports, Inc.; and Rockstar Games, Inc. (The preceding listing of non-Petitioner RPI entities should not be deemed as an acknowledgement or admission that any such entity actually controls this matter.)

[Corrected] Related Matters Under Rule § 42.8(b)(2). ABLLC has asserted claims 1, 3-6, 10, 11, and 14-16 of the '147 patent in the United States District Court for the District of Delaware in the following cases: 1:15-cv-228, 1:15-cv-282, and 1:15-cv-311. Petitioners are each defendants in one of those actions.

Petitioners have challenged other patents that applicants called “related” in the first paragraph of the specification. Specifically, petitioners filed petitions for IPR of Patent Nos. 6,701,344 (IPR2015-01970, -01972), 6,714,966 (IPR2015-01951, -01953), and 6,829,634 (IPR2015-01964, -01996). In addition to the present petition, Petitioners are also filing petitions IPR2016-00724 (challenging U.S. Pat. 6,920,497), IPR2016-00726 (challenging claims of U.S. Pat. No. 6,910,069) (corrected per previously filed Paper 3), and IPR2016-00727 (challenging claims

of the '634 patent).

Lead/Back-Up Counsel Under § 42.8(b)(3) & (4). Lead: Michael M. Murray (Reg. No. 32,537, WINSTON & STRAWN LLP, 200 Park Avenue, New York, NY 10166-4193, P: 212-294-3510 / F: 212- 294-4700, mmurray@winston.com). Backup: Andrew R. Sommer (Reg. No. 53,932, WINSTON & STRAWN LLP, 1700 K Street, N.W., Washington, D.C. 20006-3817, P: 202-282-5896 / F: 202-282-5100, asommer@winston.com), and Michael A. Tomasulo (Reg. No. 43,957, WINSTON & STRAWN LLP, 333 S. Grand Avenue, 38th Floor, Los Angeles, CA 90071-1543, P: 213-615-1848 / F: 213-615-1750, mtomasulo@winston.com). Service via hand-delivery may be made at the postal mailing address of lead and back-up counsel. Petitioners consent to service by e-mail.

III. PETITIONERS HAVE STANDING

A. Grounds For Standing Under § 42.104(A)

Petitioners certify that the '147 patent is eligible for (and that Petitioners are not barred or estopped from requesting) *inter partes* review.

B. Claims And Statutory Grounds Under §§ 42.22 And 42.104(b)

Petitioners request *inter partes* review of the Challenged '147 Claims of the '147 patent and assert that these claims are unpatentable as follows: **Ground 1:** Shoubridge, Denes, and Rufino render obvious claims 1-16; **Ground 2:** Shoubridge, Denes, Rufino, and Hirviniemi, in the alternative, render obvious claims 4-5, 14, and 16; **Ground 3:** Shoubridge, Denes, Rufino, and Balph, in the

alternative, render obvious claims 8 and 13; and **Ground 4**: Shoubridge, Denes, Rufino, and Todd render obvious claims 1-16. As will be explained below, Ground 4 is a supplement to Ground 1. The analysis for Grounds 2 and 3 can easily depend from either Ground 1 or 4. These grounds for unpatentability are discussed in detail below in Section VII. Each ground for trial is supported by the expert testimony of Dr. David Karger (Ex. 1003) and other exhibits identified throughout this Petition and Dr. Karger's declaration.

IV. SUMMARY OF THE '147 PATENT AND ITS TECHNICAL FIELD

A. Overview Of The '147 Patent

The '147 patent describes a computer network organized into an “m-regular” configuration that is “non-complete.” *See, e.g.*, Ex. 1001, Abstract, cls. 1, 6, 11; Karger ¶¶ 27-29. In an m-regular network, each “node” (typically a computer) in the network is connected to exactly “m” other nodes. *E.g.*, Ex. 1001, cls 1, 6, 11; Karger ¶¶ 27-29, ¶¶ 61-62. For example, a 4-regular network is one where each node is connected to 4 other nodes. *E.g.*, Ex. 1001, Fig. 1, 2:46-47; Karger ¶ 28. A “non-complete” network is one where at least one of the nodes is not connected to at least one other node. Karger ¶¶ 61-62. The claims are directed to methods for removing a node from the network, while maintaining the m-regular characteristic of the network. *See, e.g.*, Ex. 1001, Abstract; Karger ¶¶ 27-29.

By requiring a connection procedure as part of the process for removing a

node, the Challenged '147 Claims make it clear that the network at issue is a ***non-complete*** graph, which, as noted above, means that at least two nodes in the network are not connected to each other. Ex. 1001 at cls. 1, 6, 11; Karger ¶ 29. A ***complete*** graph, in contrast, is one that is fully connected, meaning that each node is connected to every other node. E.g., Ex. 1013 at 15, 20; Karger ¶¶ 62-63. The '147 patent is directed to a non-complete graph because a complete graph would continue to be regular when a computer is disconnected and would not need to perform any additional connection steps, such as recited in claim 1, to maintain regularity. Ex. 1001 at cls. 1, 6, 11; Karger ¶ 29. Figure 1 of the '147 patent, for example, illustrates a graph that is 4-regular and non-complete. Karger ¶ 28.

Figure 5A of the '147 patent illustrates one process of disconnecting a computer from the broadcast channel while maintaining a non-complete m-regular graph. Karger ¶ 30. The '147 patent explains that “[w]hen 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.” Ex. 1001 at 9:20-26.; Karger ¶ 30.

Notably, the '147 patent does not provide any generalized algorithm for maintaining a non-complete m-regular graph when a node disconnects, providing

instead only two examples. Karger ¶ 32. Algorithms for maintaining a non-complete m -regular graph when a node disconnects were well known in the art by July 2000, as will be discussed below in Section IV.C. *Id.*

B. Overview Of The Prosecution History

The application that led to the '147 patent was filed July 31, 2000, and applicants did not claim priority to any earlier-filed application. Ex. 1001. During prosecution, the examiner rejected original claims 9-30 as obvious in view of: (a) U.S. Patent No. 6,618,752 to Moore ("Moore") in view of U.S. Patent No. 6,353,599 to Bi ("Bi"); and (b) Moore in view of Bi in further view of "Graph Theory with Applications" by Bondy et al. ("Bondy"). Ex. 1024 at 5-11. Claims 1-8 were withdrawn due to a restriction requirement. Ex. 1025 at 8.

In response, applicants amended the preamble of each independent claim to indicate that the claim is directed to an m -regular graph where m is at least 3. Ex. 1025 at 4-6. According to applicants, Moore proposed a daisy chain arrangement where clients act as "mini-servers" to forward data to other clients. Ex. 1025 at 10. Applicants argued that Moore did not disclose an m -regular graph where m is at least 3. Ex. 1025 at 11.

Applicants also amended independent claims 1 and 11 to indicate that the disconnecting computer sends a list of its neighbors to all of its neighbors, allowing the neighbors of the disconnecting computer to contact other computers on that

list. Ex. 1025 at 4-6. Applicants added a similar limitation to claim 6. *Id.* According to applicants, this type of disconnection and healing process is not shown in the Moore or Bondy references. Ex. 1025 at 12-13.

The examiner then entered an Examiner's Amendment which amended independent claims 9 and 23 to further reflect an explicit linking to the broadcast channel and its m-regular structure. Ex. 1026 at 4. The claims were then allowed. Ex. 1026 at 1.

C. Overview Of The Technical Field And Brief Discussion Of Some Of The Relevant Prior Art

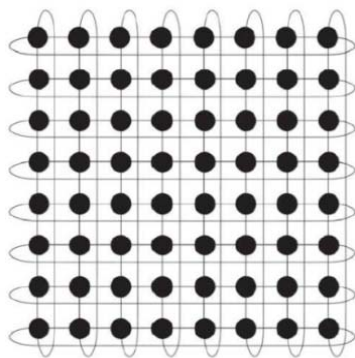
Graph theory is a branch of mathematics that involves the study of graphs, which are sets of vertices (often represented by points) connected by edges (represented by lines). Karger ¶ 57. Since long before the patent applications were filed, graph theory has been actively applied in a variety of industries and fields, including integrated circuit design, operations research, and computer networks. *Id.*

Computer networks and their topologies are routinely represented using graph theory, and mathematical proofs or simulations are often developed to model the performance and reliability of a network. *See, e.g.*, Ex. 1001 at 4:25-30 (“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.”); Ex. 1008 at 114 (“The various classes of networks are distinguished by certain topological properties of the

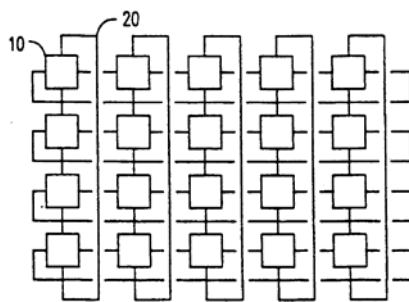
graphs that represent them, like the degree of the nodes, or whether the graph is regular or not"); Ex. 1015 at 7 ("This paper presents a study of networks which are represented as linear graphs, and it is assumed the reader is familiar with elementary notions of graph theory."); Ex. 1010 at 36 ¶ 2 ("We start this chapter by stating our topology computation problem as a graph theory problem."); Karger ¶ 58.

The use of m -regular non-complete networks was well known in the art. Karger ¶ 68. For example, Shoubridge discloses the use of a broadcast methodology known as "flooding" over m -regular, non-complete "torus" graphs, such as the graph in Figure 4.2 (shown below (left)). *Id.*; see Ex. 1005 at 1383 . (Figure 4.2 is from Ex. 1006, a 175-page Ph.D. thesis also by Peter J. Shoubridge, hereinafter "Shoubridge Thesis," which discloses the same body of work that is described in more concise form in the six-page IEEE publication of Ex. 1005 at 1386. See Ex. 1006 at 94; *id.* at 189.)¹

¹ Peter John Shoubridge, "Adaptive Strategies For Routing In Dynamic Networks," Ph.D. thesis, University of South Australia, 1996), is also prior art under § 102(b). Ex. 1006; Ex. 1020.



Ex. 1006 : Fig. 4.2



Ex. 1030: Fig. 1

Similarly, a paper by Yogen Dalal (1977) discloses the use of flooding over non-complete, 4-regular networks. Karger ¶ 68; *see* Ex. 1008 at 88-89, 157, 161. Flooding over a 4-regular “torus” network (shown above (right)) is also disclosed in U.S. Patent No. 6,122,277 (Ex. 1029) (which incorporates by reference the disclosure of U.S. Patent No. 5,181,017 (Ex. 1030)) and thus is prior art under § 102(e), as the filing date is August 19, 1997. *See* Ex. 1029 at 1:59-66, 5:29-43, 6:62; Ex. 1030 at Fig. 1; Karger ¶ 68.

Long before July 2000, a POSITA would have understood that the topology of a network could have a significant impact on the network’s characteristics, such as its performance, scalability, and reliability. Karger ¶ 67; Ex. 1015 at 6-7; Ex. 1014 at 6-12. As a result, many types of network topologies—including those based on non-complete, m -regular graphs—were well known in the art. Karger ¶¶ 67-69; Ex. 1013 at 20. These topologies were routinely represented using graph theory (with computers as nodes, and connections as edges), with mathematical

proofs or simulations developed to model the performance and reliability of the network. Karger ¶ 57-81, ¶¶ 36-45; *see, e.g.*, Ex. 1015 at 7 (“This paper presents a study of networks which are represented as linear graphs, and it is assumed the reader is familiar with elementary notions of graph theory.”); Ex. 1008 at 114 (“The various classes of networks are distinguished by certain topological properties of the graphs that represent them, like the degree of the nodes, or whether the graph is regular or not.”) (citation omitted).

Long before July 2000, a POSITA would have understood the advantages of maintaining an m -regular non-complete topology when adding or subtracting a computer (i.e., a participant or node) from the topology. *See, e.g.*, Ex. 1013 at 22 (“Regular graph: If some of the nodes in the network have less links than the others, it is likely for the network to have bottlenecks at these nodes. A regular graph has all of its edges uniformly distributed; therefore, reducing the probability of the occurrence of bottlenecks.”); Karger ¶ 69. Also, before July 2000, a POSITA would have known the generalized formulas for maintaining an m -regular non-complete topology when subtracting a node. Karger ¶ 69. For instance, Denes (Exs. 1016 and 1017) and Toida (Ex. 1018), both published in the 1970s, disclose the same (or substantially similar) simple algorithms for maintaining an m -regular non-complete topology while removing a node. *Id.* Computer networks have added and dropped nodes in the way described by these formulas prior to July 2000. *See,*

e.g., Ex. 1023 at 12:26-32 (“When upgrading from 6 nodes to 7 nodes, the network administrator utilizes the interim routing table provided below, removes links 2-0 and 4-3, and then adds links 6-0, 6-2, 6-3, and 6-4.”); Karger ¶ 69.

Denes discloses that a k-regular² non-complete topology may be maintained when a node is removed from a network. Karger ¶¶ 76-81. Denes defines the ET^{-1} operation for removing a node. Ex. 1017 at 366; Karger ¶ 76. The ET^{-1} operation is defined as: $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$; $E' = E \setminus \{(pp_1), (pp_2), \dots, (pp_k)\} \cup \{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$. *Id.* Denes discloses that the new graph (E') is the result of the disconnection of a node (p). *Id.* The edges connected to p ($\{(pp_1), (pp_2), \dots, (pp_k)\}$) are disconnected from its neighbor nodes. *Id.* Then the neighbor nodes are connected (noted by operation \cup) to one another ($\{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$). *Id.* The result is a non-complete k-regular graph. *Id.*

The following paragraphs illustrate the above-described operation of removing a node as disclosed by Denes applied to Figure 1 of the '147 patent. Karger ¶ 77. **Fig. P10** illustrates a 4-regular network where Node H is to be removed. Denes discloses that k neighbors of a node H (i.e., all its neighbors) are selected, which are the four neighbors highlighted in redlines in **Fig. P11**. Karger ¶¶ 77-78.

² Denes uses the consonant “k” instead of “m” but the meaning is the same.

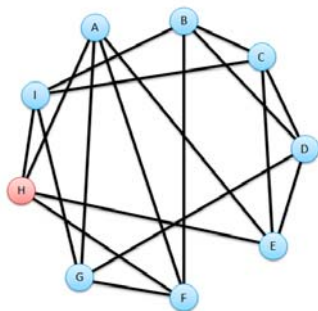


Fig. P10

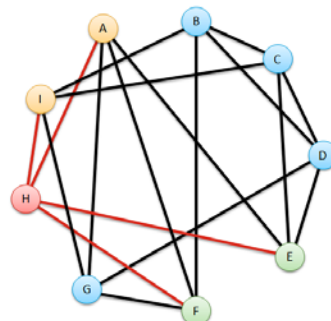


Fig. P11

Then, Denes discloses disconnecting the red edges from node H, the result of which is provided in **Fig. P12** below. Karger ¶ 79. Denes discloses that new connections are established between the neighbor nodes (A and I, E and F), which are in blue in **Fig. P13**, resulting in a 4-regular non-complete graph. Karger ¶ 80.

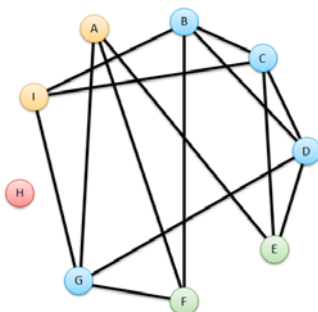


Fig. P12

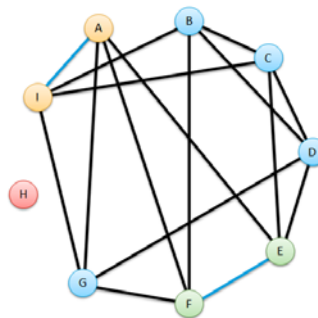


Fig. P13

V. CLAIM CONSTRUCTION UNDER § 42.104(B)(3)

Pursuant to § 42.100(b), for the purposes of this review, Petitioners construe the claim language such that it is “given its broadest reasonable construction in light of the specification of the patent in which it appears” (“BRI”). For terms not specifically listed and construed below, and in the absence (to date) of arguments

from ABLLC concerning claim construction, Petitioners interpret them for purposes of this review with their plain and ordinary meaning consistent with the specification of the '147 patent.

As used in the Challenged '147 Claims, for purposes of this review:

“**m-regular**” (cls. 1, 6, 11) means “each node is connected to exactly *m* other nodes.” *See, e.g.*, Ex. 1001 at 4:40-50, 14:51-15:6.

VI. LEVEL OF ORDINARY SKILL IN THE ART AND STATE OF THE ART

Petitioners submit that a POSITA would have a minimum of: (1) a bachelor's degree in computer science, computer engineering, applied mathematics, or a related field of study; and (2) four or more years of industry experience relating to networking protocols and network topologies. Karger ¶¶ 16-22. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education. *Id.*

VII. THERE IS A REASONABLE LIKELIHOOD THAT PETITIONERS WILL PREVAIL WITH RESPECT TO AT LEAST ONE CLAIM

Petitioners submit there is at least “a reasonable likelihood that the petitioner[s] would prevail with respect to at least one of the claims challenged in the petition.” § 314(a). Indeed, all claims are obvious under Grounds 1-4.

A. Overview Of Shoubridge

Shoubridge is a printed publication and constitutes prior art under § 102(b)³ because it was publicly accessible by early October 1997. It was first disseminated through a conference presentation in 1997. *See* Ex. 1004 at ¶ 24. The printed conference proceedings were available in at least 70 libraries. *See* Ex. 1004 at ¶ 25 and Attachments 1b and 1d. Also, the printed proceedings were disseminated online through the IEEE Xplore Digital Library starting in 1997. *See* Ex. 1004 at ¶ 27 and Attachments 1c and 1f. Thus, Shoubridge was prior art under § 102(b).

Shoubridge discloses techniques for routing messages to participants in static to very dynamic communications networks, including wireless computer networks, and draws extensively on work directed towards more general computer networking. *See* Ex. 1005 at 1381 , 1386 (References) (citing numerous works on

³ “[P]ublic accessibility’ has been called the touchstone in determining whether a reference constitutes a ‘printed publication’ bar under 35 U.S.C. § 102(b).” *Suffolk Techs., LLC v. AOL Inc.*, 752 F.3d 1358, 1364 (Fed. Cir. 2014). “A given reference is ‘publicly accessible’ upon a satisfactory showing that such document has been disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.” *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006).

computer networking and routing in computer networks); Karger ¶¶ 101-111, 254. Shoubridge models communications networks as graphs in which “[e]ach node functions as a source of user traffic entering the network.” Ex. 1005 at 1382 ¶ 5; Karger ¶¶ 101-111, 254. Nodes with a connection between them are called neighbors. Ex. 1005 at 1382 ¶ 5; Karger ¶¶ 101-111, 254.

Shoubridge compares the characteristics of multiple routing protocols, including flooding, on a network topology that is a 64-node network in which each node has connections to 4 adjacent nodes—*i.e.*, an m -regular network, where $m=4$. Ex. 1005 at 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.”); Karger ¶¶ 101-111, 254. Because at least one node in the Shoubridge 64-node topology is connected to fewer than all other nodes in the network, the network is a non-complete graph. Karger ¶¶ 61-66, 101-111, 254.

B. Overview Of Denes

Denes is also a printed publication and constitutes prior art under § 102(b) because it was publicly accessible no later than 1980. Denes is a research paper disseminated through a Hungarian mathematics journal. Printed copies of the journal were available in more than 90 libraries. *See* Ex. 1004 at ¶ 56 and Attachments 7, 7a, 7b, and 7d. Thus, Denes was prior art under § 102(b).

As discussed above in Section IV.C, Denes discloses a method of maintaining a non-complete m-regular topology when removing a node. Karger ¶ 76. This method is a mathematical formula that would have been well known to a POSITA by July 2000. *Id.* To summarize, Denes discloses the ET^{-1} operation: $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$; $E' = E \setminus \{(pp_1), (pp_2), \dots, (pp_k) \cup \{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$. Ex. 1017 at 366; Karger ¶ 76. Denes discloses that the new graph (E') is the result of the disconnection of a node (p). *Id.* The edges connected to p ($\{(pp_1), (pp_2), \dots, (pp_k)\}$) are disconnected from its neighbor nodes. *Id.* Then the neighbor nodes are connected (noted by operation \cup) to one another ($\{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$). *Id.* The result is a non-complete k-regular graph. *Id.*

C. Overview Of Rufino

Rufino is also a printed publication and constitutes prior art under § 102(b) because it was publicly accessible no later than 1995. Rufino was first publicly disseminated through a conference presentation in 1992. The conference proceedings were available in more than 200 libraries. *See* Ex. 1004 at ¶ 50 and Attachments 5, 5a, 5b, and 5d. Additionally, the proceedings were disseminated online through the IEEE Xplore Digital Library starting in 1996. *See* Ex. 1004 at ¶ 52 and Attachments 5c and 5e. Finally, Rufino was cited in 5 publications between 1995 and 1999. Thus, Rufino was prior art under § 102(b).

Rufino discloses messaging techniques for maintaining a 2-regular non-

complete network when a node is disconnected from the network. *See, e.g.*, Ex. 1011 at 0959 col. 2 ¶ 1; Karger ¶ 113. In particular, Rufino discloses that when a first computer decides to disconnect from the second computer, the first computer sends a disconnect message to the second computer, where the disconnect message includes the location of a third computer. Ex. 1011 at 0962 col. 2 ¶¶ 4-5; Karger ¶¶ 113-114. When the second computer receives the disconnect message, the second computer sends a message to connect to the third computer. *Id.* If the second computer is unable to connect to the third computer, the second computer sends a message to find another computer to which it can connect. Ex. 1011 at 0959 col. 1 ¶ 7 – col. 2 ¶ 1, 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶¶ 116-118. The goal of Rufino’s messaging techniques is to maintain an m-regular graph. *Id.*

D. Combination Of Shoubridge, Denes, And Rufino

A POSITA would have been motivated to combine the teachings of Shoubridge with the teachings of Denes and Rufino for several separate and independent reasons. Karger ¶ 119.

(a) Shoubridge Teaches The Use Of Its Network In A Dynamic Setting, And Denes And Rufino Address The Problem Of Dynamic Networks

As discussed above, a POSITA would have been motivated to combine the teachings of Shoubridge and Denes and Rufino because Shoubridge teaches that its system is used in a reliable dynamic network, and Denes and Rufino address how

to maintain an m -regular non-complete topology when removing a node. Karger ¶ 120. A POSITA would have been motivated to apply the well-known teachings of Denes and Rufino to the computer network taught by Shoubridge to improve its reliability. Karger ¶ 121.

Shoubridge discloses an exemplary 64-node, 4-regular network topology as an example of such a network environment. *E.g.*, Ex. 1005 at 1384; *id.* at 1383 (describing network model); Karger ¶ 122. Denes discloses a straightforward mathematical principle to remove a node from a network to maintain a non-complete m -regular topology, and includes an example of a 4-regular non-complete network. *See* Section IV.C above; Karger ¶ 123.

In view of Shoubridge and Denes, it would have been straightforward to apply the messaging techniques disclosed in Rufino to coordinate the implementation of the method for removing a node disclosed in Denes to Shoubridge. Karger ¶ 124. For instance, it was well known to expand the messaging techniques of Rufino to grid topologies (where $m = 4$). *See, e.g.*, Ex. 1019 1 col. 2 ¶ 2 (“In this paper, a network referred to as the token grid is introduced. The token grid is a multidimensional extension of the token ring 121, where stations share access to a mesh formed by a set of overlapping rings Couplings between the rings are implemented by the user stations in a very simple fashion and under token control.”); Karger ¶ 124.

For the reasons stated above, a POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino to maintain a non-complete m-regular topology when removing a node.

(b) Shoubridge Discloses A Non-Complete Regular Topology, And Denes And Rufino Address The Problem Of Maintaining A Non-Complete Regular Topology

Shoubridge discloses a non-complete regular topology in a dynamic network. *See* Sections VII.A; Karger ¶¶ 126-127. Denes and Rufino address the problem of maintaining a non-complete regular topology. *See* Sections VII.B-C; Karger ¶¶ 126-127. A POSITA would have been motivated to combine the teachings of all three references, because they were in the same technical field, and addressed the same technical problems. Karger ¶¶ 126-127. A POSITA thus would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino to maintain a non-complete m-regular topology when removing a node. *Id.*

E. Ground 1: Claims 1-16

1. Independent Claim 1

Claim 1	Prior Art
[Preamble] A method of disconnecting a first computer from a second computer, the first computer and the second	<i>See, e.g.,</i> Shoubridge, Ex. 1005 at 1381 Abstract (“[T]he distribution of traffic loads and network topologies may vary from nearly static to very dynamic. This dynamic behavior may vary both in space and in time.”); 1381 ¶ 3 (“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.”).

computer being connected to a broadcast channel, said broadcast channel forming an m-regular graph where m is at least 3, the method comprising:	<p><i>See, e.g., Denes, Ex. 1017 at 366 ¶ 4 (“Definition 3. Let $\Gamma_{n,k} = (P, E) \in PR_k$, $p \in P$, and we take the vertex pairs $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$ to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be: (3) $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$” and “$E' = E \setminus \{ (pp_1), (pp_2), \dots, (pp_k) \} \cup \{ (p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k) \}$”); 367 Fig 2.</i></p>
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To the extent the preamble is deemed to be a limitation of the claim, Shoubridge discloses a dynamic computer network in which computers enter and leave a non-complete m-regular network, and Denes discloses a general method of maintaining an m-regular graph when a node is removed. Karger ¶ 128.

Shoubridge also discloses networks in which each computer is connected to four (*i.e.*, at least three) neighbors in the broadcast channel. *See* Ex. 1005 at 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,”); Karger ¶ 130. Although Shoubridge alone is sufficient to meet the limitations of the preamble, should the preamble be limiting, Denes also discloses a method of disconnecting a first node from a second node, the first node and the second node being connected to a specific topology, said topology forming an m-regular graph where m is at least 3.

See Ex. 1017 at 367 ¶ 3, Fig. 2; Karger ¶ 131.

Claim 1	Prior Art
[1(a)] 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	<p>See, e.g., Shoubridge, Ex. 1005 at 1383 Abstract; 1381 ¶ 3; 1383 ¶ 2.</p> <p>See, e.g., Denes, Ex. 1017 at 366 ¶ 4.</p> <p>See, e.g., Rufino, Ex. 1011 at 0962 col. 2 ¶¶ 4-5 (“An orderly leave from a logical ring is only possible when that station holds the token. 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 <i>set_successor</i> frame addressed to its predecessor and carrying the address of its future successor.”)</p>

As noted above, Shoubridge discloses a dynamic network in an m-regular configuration. Karger ¶¶ 129-130. Denes discloses a method of disconnecting a first node from a second node in an m-regular network. See Section IV.C; Karger ¶ 133. To do this, Denes discloses connecting the neighbors of the leaving node to each other. Ex. 1017 at 366 ¶ 4; Karger ¶ 133. Specifically, Denes discloses that the new graph (E') is the result of the disconnection of a node (p). Ex. 1017 at 366 ¶ 4; Karger ¶ 133. The edges connected to p ($\{(pp_1), (pp_2), \dots, (pp_k)\}$) are disconnected from its neighbor nodes. Ex. 1017 at 366 ¶ 4; Karger ¶ 133. Then the neighbor nodes are connected (noted by operation \cup) to one another ($\{(p_1p_2),$

$(p_3p_4), \dots, (p_{k-1}p_k)\}$). Ex. 1017 at 366 ¶ 4; Karger ¶ 133.

It would have been obvious to a POSITA to use the node disconnection technique in Denes to disconnect a node in the m-regular network disclosed in Shoubridge, at least for the reason that a POSITA would understand that in a dynamic network such as Shoubridge, where nodes are being added and dropped (*see* Ex. 1005 at 1381 Abstract; *id.* at 1381 ¶ 3) it is advantageous to maintain the m-regular nature of the network to maintain the reliability of the network. *See, e.g.*, Karger ¶¶ 68-69, ¶¶ 256-265, ¶¶ 266-273. Denes discloses how to drop a node while maintaining the m-regular nature of the network. Karger ¶ 133.

Rufino discloses a disconnect method wherein when the first computer is disconnecting from the second computer, the first computer sends a disconnect message to the second computer. Ex. 1011 at 0962 col. 2 ¶¶ 4-5; Karger ¶¶ 134-136. Rufino discloses a method for a leaving station (first computer) in a token bus network to leave the logical ring in an orderly way by sending a *set_successor* frame (a disconnect message) to its predecessor station (second computer). *Id.*

Rufino discloses that a *set_successor* frame (a disconnect message) sent by the leaving station to the predecessor station includes the address of the future successor. Ex. 1011 at 0962 col. 2 ¶¶ 4-5; Karger ¶ 135. One of ordinary skill in the art would understand that the future successor is the current successor station (neighbor) of the leaving station. *Id.* Thus, Rufino discloses the use of a discon-

nect message including a list neighbors of the first computer (a single neighbor in this example). *Id.*

It would have been obvious to further modify the network of Shoubridge, as modified above to implement the node removal method of Denes, to use messages to accomplish the node removal, as taught by Rufino. Karger ¶¶ 134-136. A POSITA would understand that it is obvious when implementing the method of Denes that the nodes should be contacted in order to implement the node removal technique of Denes. Karger ¶¶ 120-125, ¶ 136. It would have been obvious to use any well-known messaging technique to accomplish the node removal, such as the messaging technique of Rufino. *Id.*

Therefore, it would have been obvious to modify Shoubridge in view of Denes in further view of Rufino so that when a node in Shoubridge is disconnected following the method taught in Denes, disconnect messages are used to accomplish that technique, including messages that include a list of neighbors of the first computer, as taught by Rufino. *Id.*

Claim 1	Prior Art
[1(b)] when the second computer receives the disconnect message from the first computer, the second	<p><i>See, e.g.,</i> Shoubridge, Ex. 1017 at 366 ¶ 4.</p> <p><i>See, e.g.,</i> Rufino, Ex. 1011 at 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”); 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.</p>

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 ¶¶ 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.”).
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As noted above, the combination of Shoubridge, Denes and Rufino yields an m-regular network (Shoubridge) and a technique for disconnecting a node in such a network (Denes) that implements the messaging necessary to accomplish the disconnection (Rufino). Karger ¶¶ 138-144.

Rufino discloses broadcasting messages on the broadcast channel to maintain a 2-regular graph. Ex. 1011 at 0960 col. 1 ¶ 3-4; Karger ¶ 140. Rufino further discloses that the management functions include a variety of actions (such as finding out the successor of a failed station (*who_follows*), soliciting any station to respond at successor querying, resolving contentions, and establishing new succes-

sors). Ex. 1011 at 0960 col. 1 ¶ 3; Karger ¶ 140. Rufino further discloses that when a station cannot successfully send a message to its successor (because of an unplanned disconnect of the successor), the station broadcasts a connection port search message on the broadcast channel to find a third computer to which it can connect to maintain a 2-regular graph. Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶ 141. To do this, the station sends a *who follows* query (connection port search message) on the broadcast channel to find the successor (the neighbor) of the disconnected station. *Id.*

As noted above, it would have been obvious to modify Shoubridge to use the technique disclosed in Denes to drop a node while maintaining the 4-regular graph, and this method of Denes involves connecting the former neighbors of the dropped node to each other. Karger ¶ 142. While Denes does not explicitly disclose the use of messaging to achieve these connections, Rufino discloses the use of messaging when dropping a node from a network. *Id.* It would have been obvious to further modify Shoubridge, when implementing the Denes node-dropping technique, to send a message including a list of multiple neighbors of the leaving station, as taught by Rufino. *Id.* In particular, it would have been obvious to modify Shoubridge in view of Denes to include the orderly leave in Rufino, with the step of broadcasting a *who follows* query (connection port search message) on the broadcast channel. *Id.* Broadcasting the *who follows* query allows the second

computer to find a third computer to connect, the third computer being one of the multiple neighbors of the leaving station, to maintain the m-regular graph. *Id.*

A POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino for the reasons discussed above, which together disclose every limitation of claim 1. Karger ¶¶ 143-144.

2. Dependent Claim 2

Claim 2	Prior Art
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.	<p>See the citations above with respect to claim 1, incorporated herein.</p> <p><i>See, e.g.,</i> Rufino, 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.”).</p>

Rufino discloses that if a station (first computer) leaves abruptly, then a recovery procedure is tried. Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶ 146. During this period, a response (port connection message) from the successor of the failed station (third computer) will be received by the second computer, and

a connection between the second and third computer will be established. *Id.* A POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, as discussed above, which together disclose every limitation of this claim. Karger ¶ 147. In particular, it would have been obvious to modify Shoubridge to implement the Denes node dropping technique, and to use the recovery procedure disclosed in Rufino. Karger ¶ 148.

3. Dependent Claim 3

Claim 3	Prior Art
The method of claim 1 wherein the first computer disconnects from the second computer after sending the disconnect message.	<p>See the citations above with respect to claim 1, incorporated herein.</p> <p><i>See, e.g.,</i> Rufino, 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.”).</p>

Rufino discloses a method for a leaving station (first computer) to disconnect from its predecessor station (second computer) by sending a *set_successor* frame (a disconnect message). Ex. 1011 at 0962 col. 2 ¶¶ 4-5; Karger ¶ 150. A POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of this claim. Karger ¶¶ 151-152. In particular, it would have been obvious to modify Shoubridge to implement the Denes node dropping technique, and to use the recovery procedure

disclosed in Rufino, thereby achieving all of the elements of claim 3. *Id.*

4. Dependent Claims 4 and 5

Claims 4-5	Prior Art
4. The method of claim 1 wherein the broadcast channel is implemented using the Internet.	See the citations above with respect to claim 1, incorporated herein. <i>See, e.g., Shoubridge, Ex. 1005 at 1381 ¶ 1</i> (“In addition to successfully forwarding user traffic between source and destination nodes in a communications network, the routing function generally seeks to optimise some performance criteria such as network utilisation or throughput, or perhaps average delay. As networks increase in size, with more users demanding seamless connectivity, mobility and a high level of availability, the task of routing becomes an increasingly complex problem to network providers.”).
5. The method of claim 1 wherein the first computer and second computer are connected via a TCP/IP connection.	

It would have been obvious to a POSITA to implement the “communications networks” disclosed in Shoubridge on the Internet as required by claim 4, as the Internet is the best-known example of a computer-based communications network and would have been among the first communications networks to occur to a POSITA, and certainly an obvious and straightforward choice, in implementing the teachings of Shoubridge. Karger ¶¶ 154-155. Likewise, it would have been obvious to implement claim 5 because TCP/IP communication forms the backbone of such well-known networks as the Internet. *Id.* A POSITA would have also been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of claims 4 and 5. Karger ¶¶ 156-157.

5. Independent Claim 6

Claim 6	Prior Art
<p>[Preamble] A method for healing a disconnection of a first computer from a second computer, the computers being connected to a broadcast channel, said broadcast channel being an m-regular graph where m is at least 3, the method comprising:</p>	<p><i>See, e.g.,</i> Shoubridge, Ex. 1005 at 1381 Abstract (“the distribution of traffic loads and network topologies may vary from nearly static to very dynamic. This dynamic behavior 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.”).</p> <p><i>See, e.g.,</i> Denes, Ex. 1017 at 366 ¶ 4 (“Definition 3. Let $\Gamma_{n,k} = (P, E) \in PR_k$, $p \in P$, and we take the vertex pairs $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$ to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be: (3) $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$ and “$E' = E \setminus \{ (pp_1), (pp_2), \dots, (pp_k) \} \cup \{ (p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k) \}$”); 367 Fig. 2.</p>

To the extent the preamble is deemed to be a limitation of the claim, Shoubridge discloses a dynamic computer network in which connections between computers may fail or become congested as well as enter and leave a non-complete m-regular network, and Denes discloses a general method of maintaining an m-regular graph when a node is removed from the network. Karger ¶¶ 161-162.

Shoubridge also discloses networks in which each computer is connected to

four (*i.e.*, at least three) neighbors in the broadcast channel. *See* Ex. 1005 at 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”); Karger ¶¶ 161-162.

The combination of Shoubridge and Denes renders this element obvious. Denes discloses a method of maintaining a non-complete *m*-regular graph when a node is removed from the graph, said graph forming an *m*-regular graph where *m* is at least 3. *See* Ex. 1017 at 367 Fig. 2; Karger ¶ 163.

Claim 6	Prior Art
[6(a)] attempt- ing to send a message from the first comput- er to the second comput- er; and	<p><i>See, e.g.</i>, Shoubridge, Ex. 1005 at 1381 Abstract; 1381 ¶ 3; 1383 ¶ 2.</p> <p><i>See, e.g.</i>, Denes, Ex. 1017 at 366 ¶ 4; 367 Fig. 2.</p> <p><i>See, e.g.</i>, Rufino, 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 pro-</p>

cedures.”).

As noted above, Shoubridge discloses a dynamic network in an m-regular configuration. Karger ¶¶ 161-163. Denes discloses a method of disconnecting a first node from a second node in an m-regular network. *See* Section IV.C; Karger ¶ 163. To do this, Denes discloses connecting the neighbors of the leaving node to each other. Ex. 1017 at 366 ¶ 4; Karger ¶ 163. Specifically, Denes discloses that the new graph (E') is the result of the disconnection of a node (p). *Id.* The edges connected to p ($\{(pp_1), (pp_2), \dots, (pp_k)\}$) are disconnected from its neighbor nodes. *Id.* Then the neighbor nodes are connected (noted by operation \cup) to one another ($\{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$). *Id.* For example, when applying the claims to Denes as implemented in Shoubridge, the “first computer” would be p_1 and the “second computer” (i.e., the computer leaving the network) would be p . *Id.*

It would have been obvious to a POSITA to use the node disconnection technique in Denes to disconnect a node in the m-regular network disclosed in Shoubridge, at least for the reason that a POSITA would understand that in a dynamic network such as Shoubridge, where nodes are being added and dropped (Ex. 1005 at 1381 Abstract, 1381 ¶ 3) it is advantageous to maintain the m-regular nature of the network to maintain the reliability of the network. *See, e.g.,* Karger ¶¶ 68-69, ¶¶ 256-265, ¶¶ 266-273. Denes discloses how to drop a node while maintaining the m-regular nature of the network. Karger ¶ 163.

Rufino discloses a dynamic computer network in which the sudden removal of a computer from a network causes problems, and proposes a solution. Ex. 1011 at 0958 col. 2 ¶ 4; Karger ¶ 165. Rufino discloses a method for a station (second computer) in a network to leave the network in an abrupt way from its predecessor station (first computer). Ex. 1011 at 0959 col. 1 ¶ 7 – col. 2 ¶ 1; Ex. 1011 at 0962 col. 2 ¶¶ 4-5 (“Stations may leave the logical ring either in an abrupt or orderly way.”); Karger ¶ 166. Rufino discloses that when a station cannot successfully send a message to its successor (because of an unplanned disconnect of the successor), the station broadcasts a connection port search message on the broadcast channel to find a third computer to which it can connect to maintain a 2-regular graph. Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1 (“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.”); Karger ¶ 167.

It would have been obvious to a POSITA that, when implementing the node disconnection technique of Denes in the network of Shoubridge, the nodes could communicate with each other to implement the Denes technique. Karger ¶ 168. A POSITA would have further applied any well-known messaging technique to ac-

comply with the communication between nodes, including the techniques of Rufino, one of which specifically teaches how to identify a failed port, namely “attempting to send a message from the first computer to the second computer” as claimed. Rufino discloses, as shown above, that an attempted transmission can be used to identify a failed node in the network. *Id.*

Claim 6	Prior Art
<p>[6(b)] when the attempt to send the message is unsuccessful, broadcasting from the first computer a connection port search message indicating that the first computer needs a connection; and</p>	<p><i>See, e.g.,</i> Shoubridge, Ex. 1005 at 1381 Abstract; 1381 ¶ 3; 1383 ¶ 2.</p> <p><i>See, e.g.,</i> Denes, Ex. 1017 at 366 ¶ 4; 367 Fig 2.</p> <p><i>See, e.g.,</i> Rufino, 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.”).</p>

Rufino discloses that when a station cannot successfully send a message to its successor (because of an unplanned disconnect of the successor), the station broadcasts a connection port search message on the broadcast channel to find a

third computer to which it can connect to maintain a 2-regular graph. Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶ 170. To do this, the station sends a who follows query (connection port search message) on the broadcast channel to find the successor (the neighbor) of the disconnected station. Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶ 170.

When applying this technique to Shoubridge employing the node removal technique of Denes in a 4-regular configuration, a POSITA would have understood that the Rufino technique of sending a query or broadcasting could have been used to identify all four neighbors in the network which Denes teaches must be found to return the network to a 4-regular configuration. Karger ¶ 170. In particular, when computer p in Denes leaves the network, computers p₁, p₂, p₃, and p₄ must locate each other to connect, as taught by Denes. *Id.* A POSITA would have understood that any well-known messaging technique could have been used to identify the neighbors for connection, including that taught by Rufino. *Id.*

Claim 6	Prior Art
[6(c)] having a third computer not al- ready connected to said first com- puter re- spond to	<p><i>See, e.g.,</i> Shoubridge, Ex. 1005 at 1381 Abstract; 1381 ¶ 3; 1383 ¶ 2.</p> <p><i>See, e.g.,</i> Denes, Ex. 1017 at 3677 ¶ 4 (“Definition 3. Let $\Gamma_{n,k} = (P, E) \in PR_k$, $p \in P$, and we take the vertEx. pairs $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$ to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be: (3) $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$” and “$E' = E \setminus \{ (pp_1), (pp_2), \dots, (pp_k) \} \cup \{ (p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k) \}$”); 367 Fig. 2.</p> <p><i>See, e.g.,</i> Rufino, Ex. 1011 at 0960 col. 1 ¶ 3-4 (“Several types of protocol data frames are exchanged between peer MAC entities, in order</p>

said connection port search message in a manner as to maintain an m-regular graph.	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.”); 0960 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.”).
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As noted above, Denes discloses connecting the neighbors of the leaving node to each other. Ex. 1017 at 366 ¶ 4; Karger ¶ 172; *see* Section IV.C. Specifically, Denes discloses that the new graph (E') is the result of the disconnection of a node (p). *Id.* The edges connected to p ($\{(pp_1), (pp_2), \dots, (pp_k)\}$) are disconnected from its neighbor nodes. *Id.* Then the neighbor nodes are connected (noted by operation \cup) to one another ($\{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$). *Id.* Thus, Denes explicitly teaches that a “third computer” (e.g., p_2) that is not already connected to the “first computer” (e.g., p_1) must connect (to form the connected pair (p_1p_2)). *Id.*

To the extent Denes does not explicitly disclose how p_1 and p_2 find each other in order to connect, Rufino discloses broadcasting messages on the broadcast channel to maintain a regular graph. Ex. 1011 at 0960 col. 1 ¶ 3-4; Karger ¶ 173. Rufino discloses that the management functions include a variety of actions (such

as finding out the successor of a failed station (who_follows), soliciting any station to respond at successor querying, resolving contentions, and establishing new successors). *Id.* Rufino discloses that when a station cannot successfully send a message to its successor (because of an unplanned disconnect of the successor), the station broadcasts a connection port search message on the broadcast channel to find a third computer to which it can connect to maintain a regular graph. 0960 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶ 174. To do this, the station sends a who follows query (connection port search message) on the broadcast channel to find the successor (the neighbor) of the disconnected station. *Id.*

When implementing Denes in a network such as Shoubridge, as discussed above, a POSITA would have understood that to maintain an m-regular network upon disconnect of a computer, the neighbors of the disconnected computer must connect to one of the other neighbors, e.g., p_1 must connect to p_2 . Karger ¶¶ 175-176. Therefore, it would have been obvious to modify Shoubridge in view of Denes in further view of Rufino to have a third computer (such as p_2) not already connected to said first computer (such as p_1) respond to said connection port search message in a manner as to maintain an m-regular graph. *Id.*

A POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of claim 6 for the reasons discussed above, e.g., a POSITA would understand that there are

benefits to maintaining a 4-regular network when removing a node and so would be motivated to use a method such as that disclosed in Denes when a node is removed in the computer network of Shoubridge. *Id.* A POSITA would similarly have been motivated to use the messaging technique of Rufino to efficiently implement the node dropping technique of Denes. *Id.*

6. Dependent Claim 7

Claim 7	Prior Art
<p>The method of claim 6 including:</p> <p>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.</p>	<p>See the citations above with respect to claim 6, incorporated herein.</p> <p><i>See, e.g.,</i> Rufino, 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 procedure.”).</p>

Rufino discloses that when the successor of the failed station (third comput-

er), which needs a connection due to failure of its predecessor, receives the “*who follows query*” (port search message), then it will send a message (*set_successor* packet) to the predecessor of the failed station (first computer), and a connection between the first and third computer will be established. Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶¶ 178-179. As explained above, it would have been obvious to modify Shoubridge to employ the method of Denes to remove a node from a network. Karger ¶ 180. Denes teaches that, when removing a node in, e.g., a 4-regular network, the nodes formerly connected to the removed node must connect. *Id.* A POSITA would have considered it obvious to use the messaging protocols of Rufino in order for former neighbors of the removed node to locate each other and connect, thus rendering this claim obvious. *Id.* For the reasons addressed above, a POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of this claim. Karger ¶¶ 181-182.

7. Dependent Claim 8

Claim 8	Prior Art
The method of claim 7 including: when the first computer receives the message proposing that the first computer and third comput-	See the citations above with respect to claim 7, incorporated herein. <i>See, e.g.,</i> Rufino, 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.

er 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.	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 procedure.”).
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Shoubridge in view of Denes and Rufino renders obvious the method of claim 8 which adds to claim 7 the requirement that “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.” Karger ¶ 183. As described above, Rufino teaches the connection method described in claim 7. Karger ¶ 184. Rufino also discloses this limitation of claim 8 because Rufino discloses in response to a who follows query, “the current token holder will receive . . . a response from the successor of the failed station. This establishes a new successor for the current token holder and ends the recovery procedure.” Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶ 184. Accordingly, a POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of this claim (*see also* Section VIII.E above). Karger ¶¶ 185-186.

8. Dependent Claim 9

Claim 9	Prior Art
The method of claim 6 wherein each computer connected to the broadcast channel is connected to at least three other computers.	<p>See the citations above with respect to claim 6, incorporated herein.</p> <p><i>See, e.g., Shoubridge, Ex. 1005 at 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.”).</i></p>

As discussed above, Shoubridge discloses networks in which each computer is connected to four (*i.e.*, at least three) neighbors in the broadcast channel. *See* Ex. 1005 at 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,”); Karger ¶ 190. A POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, as discussed above, which together disclose every limitation of claim 9. Karger ¶ 190.

9. Dependent Claim 10

Claim 10	Prior Art
The method of claim 6 wherein the broadcasting includes sending the	<p>See the citations above with respect to claim 6, incorporated herein.</p> <p><i>See, e.g., Shoubridge, Ex. 1005 at 1381 ¶ 1 (“In addition to successfully forwarding user traffic between source and destination nodes in a communications network, the routing function generally seek</i></p>

message to each computer to which the first computer is connected.	to optimize some performance criteria such as network utilization or throughput, or perhaps average delay.”); 1382 ¶ 11 to 1383 ¶ 1 (“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 packer was originally received on.”).
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As a threshold matter, claim 6 recites the sending of two different types of messages. Karger ¶ 192. It is unclear which message “the message” of claim 10 is referring to. *Id.* Regardless, the addition of this limitation is trivial and obvious in light of the prior art. *Id.*

Shoubridge discloses a network in which a participant uses a flooding algorithm to propagate a message to all of its neighbors and in which packets are broadcast to all participants. *See, e.g.*, Ex. 1005 at 1381 ¶ 1; 1382 ¶ 11 to 1383 ¶ 1; 1383 ¶ 3; Karger ¶ 193. It would have been obvious to a POSITA to broadcast any message to each computer to which a first computer is connected because the well-known flooding technique results in messages being sent to the entire network, which, for instance, necessarily includes the computers connected to a computer originating a message. Karger ¶ 194. Accordingly, a POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, for the reasons discussed above, which together disclose every limitation of claim 10. Karger ¶¶ 195-196.

10. Independent Claim 11

Claim 11	Prior Art
<p>[Preamble] 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:</p>	<p>See the citations above with respect to claim 1 [Preamble], incorporated herein.</p> <p><i>See, e.g.</i>, Shoubridge, Ex. 1005 at 1381 Abstract (“[T]he distribution of traffic loads and network topologies may vary from nearly static to very dynamic. This dynamic behavior may vary both in space and in time.”); 1381 ¶ 3 (“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.”).</p> <p><i>See, e.g.</i>, Denes, Ex. 1017 at 366 ¶ 4 (“Definition 3. Let $\Gamma_{n,k} = (P, E) \in PR_k$, $p \in P$, and we take the vertex pairs $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$ to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be: (3) $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$” and “$E' = E \setminus \{ (pp_1), (pp_2), \dots, (pp_k) \} \cup \{ (p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k) \}$”); 367 Fig. 2.</p>

To the extent the preamble is deemed to be a limitation of the claim, Shoubridge discloses a dynamic computer network in which computers enter and leave a non-complete m-regular network, and Denes discloses a general method of maintaining an m-regular graph when a node is removed from the network. Karger ¶ 197. Shoubridge also discloses networks in which each computer is connected to four (*i.e.*, at least three) neighbors in the broadcast channel. *See* Ex. 1005 at 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”); Karger ¶ 198. Shoubridge and Denes also discloses a method of disconnecting a first node from a second node, the first node and the second node being connected to a specific topology, said topology forming an m -regular graph where m is at least 3. *See* Ex. 1017 at 367 Fig. 2 (above); Karger ¶ 198.

To the extent that Shoubridge and Denes do not specifically disclose storing instructions for implementing their disclosed techniques on a “computer readable medium” it was certainly well known and obvious to persons of ordinary skill for decades that software for implementing instructions in a network can be stored, indeed must be stored, on a computer-readable medium. Karger ¶ 198.

Claim 11	Prior Art
<p>[11(a)] a component that, when the computer decides to disconnect from the other computer, the computer sends a disconnect message to the other computer,</p>	<p><i>See the citations above with respect to claim 1(a), incorporated herein.</i></p> <p><i>See, e.g.,</i> Denes, Ex. 1017 at 366 ¶ 4 (“Definition 3. Let $\Gamma_{n,k} = (P, E) \in PR_k$, $p \in P$, and we take the vertex pairs $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$ to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be: (3) $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$ and “$E' = E \setminus \{ (pp_1), (pp_2), \dots, (pp_k) \} \cup \{ (p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k) \}$”); 367 Fig. 2.</p> <p><i>See, e.g.,</i> Rufino, Ex. 1011 at 0962 col. 2 ¶¶ 4-5 (“Stations may leave the logical ring either in an abrupt or orderly way. . . . An orderly leave from a logical ring is only possible when that station holds the token. Station withdrawal is achieved through a ring patch between its predecessor and successor stations. For that purpose,</p>

said disconnect message including a list of neighbors of the computer	the leaving station before passing the token issues a <i>set_successor</i> frame, addressed to its predecessor, and carrying the address of its future successor.”)
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As noted above, Shoubridge discloses a dynamic network in an m-regular configuration. Karger ¶ 200. Denes discloses a method of disconnecting a first node from the second node in an m-regular graph. *Id.* To accomplish the disconnection while maintaining the regular nature of the graph, Denes discloses connecting the neighbors of the leaving node to each other. Ex. 1017 at 366 ¶ 4; Karger ¶ 200. Specifically, Denes discloses that the new graph (E') is the result of the disconnection of a node (p). *Id.* The edges connected to p ($\{(pp_1), (pp_2), \dots, (pp_k)\}$) are disconnected from its neighbor nodes. *Id.* Then the neighbor nodes are connected (noted by operation \cup) to one another ($\{(p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k)\}$). *Id.* The result is a non-complete k-regular graph. *Id.*

As explained above in connection with claims 1 and 6, it would have been obvious to a POSITA to use the node disconnection technique in Denes to disconnect a node in the m-regular network disclosed in Shoubridge, at least for the reason that a POSITA would understand that in a dynamic network such as Shoubridge, where nodes are being added and dropped (Ex. 1005 at 1381 Abstract; *id.* at 1381 ¶ 3) it is advantageous to maintain the regular nature of the network to

maintain the reliability of the network. *See, e.g.*, Karger ¶¶ 68-69, ¶¶ 256-265, ¶¶ 266-273. Denes discloses how to drop a node while maintaining the m-regular nature of the network. Ex. 1017 at 366 ¶ 4; Karger ¶ 200.

Rufino discloses a disconnect method wherein when the first computer decides to disconnect from the second computer, the first computer sends a disconnect message to the second computer. Ex. 1011 at 0962 col. 2 ¶¶ 4-5; Karger ¶ 200. For example, Rufino discloses a method for a leaving station (first computer) in a token bus network to leave the logical ring in an orderly way by sending a *set_successor* frame (a disconnect message) to its predecessor station (second computer). *Id.* Rufino discloses that a *set_successor* frame (a disconnect message) sent by the leaving station to the predecessor station includes the address of the future successor. *Id.* One of ordinary skill in the art would understand that the future successor is the current successor station (neighbor) of the leaving station. *Id.* Thus, Rufino discloses the use of a disconnect message including a list neighbors of the first computer (a single neighbor in this example). *Id.*

It would have been obvious to a POSITA that, when implementing the node disconnection technique of Denes in the network of Shoubridge, the nodes could communicate with each other to implement the Denes technique. *Id.* A POSITA would have further applied any well-known messaging technique to accomplish the communication between nodes, including the techniques of Rufino, one of

which specifically teaches the use of a disconnect message with a list of neighbors, as discussed above. *Id.*

Furthermore, the use of the term “component” in claim 11 refers generally to a collection of software instructions that carries out the steps recited in the elements of the claims. Karger ¶ 201. This is consistent with the specification of the ’147 patent. *See, e.g.*, Ex. 1001 at 15:27-40; Karger ¶ 201. A POSITA would have understood that the computer based-methods disclosed in Shoubridge and Rufino could, and ordinarily would, be implemented using software. Karger ¶ 202. Thus, the disclosures of Shoubridge and Rufino, when implemented in software, would necessarily and inherently include “components” as used in claim 11. *Id.* At the very least it would have been obvious to use such components. *Id.*

Therefore, it would have been obvious to modify Shoubridge in view of Denes and Rufino so that when a node in Shoubridge is disconnected following the method taught in Denes, then a disconnect message may be used that includes a list of neighbors of the first computer, as taught by Rufino. Karger ¶ 199.

Claim 11	Prior Art
[11(b)] a component that, when the computer receives a disconnect message from another computer,	<p>See the citations above with respect to claim 1(b), which are incorporated herein.</p> <p><i>See, e.g.</i>, Denes, Ex. 1017 at 366 ¶ 4 (“Definition 3. Let $\Gamma_{n,k} = (P, E) \in PR_k$, $p \in P$, and we take the vertex pairs $p_1p_2, p_3p_4, \dots, p_{k-1}p_k$ to be neighbors of p but pairwise not neighbors. Then we take the ET transformation to be: (3) $ET^{-1}: \Gamma_{n,k} \rightarrow \Gamma_{n-1} = (P', E')$, $P' = P \setminus \{p\}$ and “$E' = E \setminus \{ (pp_1), (pp_2), \dots, (pp_k) \cup \{ (p_1p_2), (p_3p_4), \dots, (p_{k-1}p_k) \}$”); 367 Fig. 2.</p>

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.	<i>See, e.g.,</i> Rufino, 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.”).
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As discussed above, Denes discloses a method of removing nodes in order to maintain an m-regular graph, and it would have been obvious to apply this technique to the network of Shoubridge. Karger ¶ 204. In particular, Denes discloses connecting the neighbors of the leaving node to each other. Ex. 1017 at 366 ¶ 4; Karger ¶ 204. A POSITA would understand that the neighbors can communicate with each other in order to connect as disclosed in Denes, and it would have been obvious to implement such communications. Karger ¶ 205.

Rufino discloses broadcasting messages on the broadcast channel to main-

tain a regular graph. Ex. 1011 at 0960 col. 1 ¶ 3-4; Karger ¶ 204. Rufino further discloses that the management functions include a variety of actions (such as finding out the successor of a failed station (`who_follows`), soliciting any station to respond at successor querying, resolving contentions, and establishing new successors). Ex. 1011 at 0960 col. 1 ¶ 3; Karger ¶ 204. Rufino further discloses that when a station cannot successfully send a message to its successor (because of an unplanned disconnect of the successor), the station broadcasts a connection port search message on the broadcast channel to find a computer to which it can connect to maintain a regular graph. *Id.* To do this, the station sends a `who_follows` query (connection port search message) on the broadcast channel to find the successor (the neighbor) of the disconnected station. Ex. 1011 at 0962 col. 2 ¶ 9; Karger ¶ 204.

As noted above, it would have been obvious to modify Shoubridge to use the technique disclosed in Denes to drop a node while maintaining the 4-regular graph, and this method of Denes involves connecting the former neighbors of the dropped node to each other. Karger ¶ 203-206. While Denes does not explicitly disclose the use of messaging to achieve these connections, Rufino discloses the use of messaging when dropping a node from a network. *Id.* It would have been obvious to further modify Shoubridge, when implementing the Denes node-dropping technique, to send a message including a list of multiple neighbors of the leaving sta-

tion, as taught by Rufino. *Id.* In particular, it would have been obvious to modify Shoubridge in view of Denes to include the orderly leave in Rufino, with the step of broadcasting a who_follows query (connection port search message) on the broadcast channel. *Id.* Broadcasting the who follows query allows the second computer to find a third computer to connect, the third computer being one of the multiple neighbors of the leaving station, to maintain the m-regular graph. *Id.* A POSITA would have been motivated to implement the messaging of Rufino to achieve the advantages disclosed in Rufino, including, e.g., avoiding asynchrony and inconsistency. Ex. 1011 at 0958 col. 2 ¶ 4; Karger ¶ 203-206.

Furthermore, the use of the term “component” in claim 11 refers generally to a collection of software instructions that carries out the steps recited in the elements of the claims. Karger ¶ 204. This is consistent with the specification of the ’147 patent. *See e.g.*, Ex. 1001 at 15:27-40; Karger ¶ 204. A POSITA would have understood that the computer based-methods disclosed in Shoubridge and Rufino could, and ordinarily would, be implemented using software. Karger ¶ 204. Thus, the disclosures of Shoubridge and Rufino, when implemented in software, would necessarily and inherently include “components” as used in claim 11. *Id.*

A POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino for the reasons discussed above, which together disclose every limitation of claim 11. Karger ¶¶ 205-206.

11. Dependent Claim 12

Claim 12	Prior Art
<p>The computer-readable medium of claim 11 including:</p> <p>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.</p>	<p>See the citations above with respect to claim 11, which are incorporated herein. See also the citations above with respect to claim 7, which are also incorporated herein.</p> <p><i>See, e.g.,</i> Rufino, 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.”)</p>

Rufino discloses that when the successor of the failed station (third computer), which needs a connection request due to failure of its predecessor, receives the “who follows query” (port search message), then it will send a message (set_successor packet) to the predecessor of the failed station (first computer), and a connection between the first and third computer will be established. Ex. 1011 at

0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶ 208. As explained above, it would have been obvious to modify Shoubridge to employ the method of Denes to remove a node from a network. Karger ¶ 209. Denes teaches that, when removing a node in, e.g., a 4-regular network, the nodes formerly connected to the removed node must connect. *Id.*; see Section IV.C. A POSITA would have considered it obvious to use the messaging protocols of Rufino in order for former neighbors of the removed node to locate each other and connect, thus rendering this claim obvious. Karger ¶¶ 209-210. For the reasons addressed above, a POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of claim 12. *Id.*

12. Dependent Claim 13

Claim 13	Prior Art
<p>The computer-readable medium of claim 12 including:</p> <p>a component that, when the computer receives a port connection message, connecting to the computer that sent the port connec-</p>	<p>See the citations above with respect to claim 12, which are incorporated herein. See also the citations above with respect to claim 8, incorporated herein.</p> <p><i>See, e.g.,</i> Rufino, 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 procedure.”).</p>

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Shoubridge in view of Denes and Rufino renders obvious claim 13, which adds to claim 12 the additional requirement that “a component that, when the computer receives a port connection message, connecting to the computer that sent the port connection message.” Karger ¶ 211. As described above, Rufino teaches the connection method described in claims 7 and 12. Karger ¶ 212. Rufino also discloses this limitation of claim 13 because Rufino discloses in response to a who follows query, “the current token holder will receive . . . a response from the successor of the failed station. This establishes a new successor for the current token holder and ends the recovery procedure.” Ex. 1011 at 0962 col. 2 ¶ 9 – 0963 col. 1 ¶ 1; Karger ¶ 212. A POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of this claim (*see* Section VIII.E above). Karger ¶ 213.

13. Dependent Claims 14 and 16

Claims 14, 16	Prior Art
14. The computer-readable medium of claim 11 wherein the computers are connected via a TCP/IP connection.	<p><i>See the citations above with respect to claim 11, which are incorporated herein. See also the citations above with respect to claims 4 and 5, incorporated herein.</i></p> <p><i>See, e.g.,</i> Shoubridge, Ex. 1005 at 1381 ¶ 1 (“In addition to successfully forwarding user traffic between source and destination nodes in a communications network, the routing function generally seeks to optimise some performance criteria such as network utilisation or throughput, or perhaps average delay. As networks increase in size, with more users demanding seamless connectivi-</p>

16. The computer-readable medium of claim 11 wherein the broadcast channel is implemented using the Internet.	ty, mobility and a high level of availability, the task of routing becomes an increasingly complex problem to network providers.”); 1381 ¶ 3 (“Algorithms that can determine shortest paths between source and destination nodes are typically used in static or quasi-static networks.”); 1381 ¶ 4 (“Routing by flooding is often used in very dynamic networks where destination nodes are highly mobile or topological changes occur very frequently and therefore the network connectivity is uncertain.”)
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As discussed above, Denes discloses a method of removing nodes in order to maintain an m-regular graph, and it would have been obvious to apply this technique to the network of Shoubridge. Karger ¶¶ 219-220. It would furthermore have been obvious to a POSITA to implement the “communications networks” disclosed in Shoubridge on the Internet as required by claim 16, as the Internet was the best-known example of a computer-based communications network and would have likely been among the first communications network to occur to a POSITA, and certainly an obvious and straightforward choice, in implementing the teachings of Shoubridge. *See, e.g.*, Ex. 1005 at 1381 ¶ 1; Karger ¶ 220. Likewise, it would have been obvious to implement claim 14 because TCP/IP communication forms the backbone of such well-known networks as the Internet. *Id.* A POSITA would have also been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of claims 14 and 16. Karger ¶ 222.

14. Dependent Claim 15

Claim 15	Prior Art
The computer-readable medium of claim 11 wherein the computers that are connected to the broadcast channel are peers.	<p>See the citations above with respect to claim 11, which are incorporated herein.</p> <p><i>See, e.g.,</i> Shoubridge, Ex. 1005 at 1383 ¶ 2 (“manhattan grid network that has been wrapped around itself as a torus”); 1382-1383 (“Each node functions as a source of user traffic entering the network where traffic can be destined to all other nodes within the network”); <i>id.</i> (“[t]he total load entering (and leaving) the network, $\gamma = \sum_{n=1}^N \gamma_n$, is evenly distributed across all N nodes.”)</p>

Shoubridge discloses a network in which all nodes are peers, and in which the connections are peer-to-peer connections. Shoubridge discloses a network model in which each node is a source of user traffic, and user traffic is evenly distributed across all nodes. Ex. 1005 at 1383 ¶ 2; Karger ¶¶ 224-225. All of the participants on such a network are peers, and the connections are peer-to-peer. *Id.* For the reasons addressed above, a POSITA would have been motivated to combine the teachings of Shoubridge, Denes, and Rufino, which together disclose every limitation of this claim. Karger ¶ 226-228.

F. Ground 2: Claims 4-5, 14, 16

Claims 4 and 14 add to claims 1 and 11, respectively, the additional limitation that “the broadcast channel is implemented using the Internet.” Claims 5 and 16 add to claims 1 and 11, respectively, the additional limitation that the subject computers are “connected via a TCP/IP connection.” To the extent the Board be-

believes an explicit teaching of implementing networks over the Internet using TCP/IP is necessary, the limitations are rendered obvious by Shoubridge, Denes, Rufino, and Hirviniemi. Hirviniemi is a U.S. patent and constitutes prior art under § 102(b) because it was issued on September 1, 1998.

Hirviniemi teaches that, by October 1997, it would have been advantageous, obvious, and routine, in light of Shoubridge's disclosure of "communications network[s]," and Rufino's network messaging techniques, to implement the disclosed networks/broadcast channels using Internet and TCP/IP connections. *See, e.g.* Ex. 1021 at 5:2-3 ("A method of interfacing a transmission control protocol/internet protocol(TCP/IP) software designed for a local area network (LAN) to a wide area network (WAN)"); Karger ¶¶ 158-160, ¶¶ 219-222. For instance, Hirviniemi discloses software that connects a local area network (such as the network disclosed in Rufino) to a wide area network (e.g. the Internet) using TCP/IP. Ex. 1021 at 5:2-3; Karger ¶¶ 158-160, ¶¶ 219-222.

It would have been clear to a POSITA in view of Hirviniemi that "Internet" and "TCP/IP connections" could be implemented on the network/broadcast channels disclosed in Shoubridge and Rufino, using techniques that were well-known in the art and that would have provided the expected, predictable results. Karger ¶¶ 158-160, ¶¶ 219-222. A POSITA would have been motivated to do so for any number of reasons that were also well known in the art, including, for example, en-

asuring the compatibility and usefulness of the disclosed communications network, given the popularity and mass reach of the Internet at the time. *Id.* A POSITA would have also been motivated to combine the teachings of Shoubridge, Denes, Rufino, and Hirviniemi, which together disclose every limitation of claims 4 and 5. *Id.*

G. Ground 3: Claims 8 and 13

Claim 8 adds to claim 7 the limitation that “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.” Claim 13 adds to claim 12 the limitation that “a component that, when the computer receives a port connection message, connecting to the computer that sent the port connection message.” In short, both of these dependent limitations relate to connecting computers in response to a proposal to connect/port connection message. To the extent the Board believes the aforementioned limitations are not disclosed by Rufino, the limitations are rendered obvious by Shoubridge, Denes, Rufino, and Balph. Balph is a U.S. patent and constitutes prior art under § 102(b) because it was issued on October 13, 1987.

Balph discloses that, in order to confirm a connection the connection can be used, “protocols are used to determine how and when each station may transmit.”

Ex. 1022 at 1:17-36; Karger ¶¶ 187-189, ¶¶ 215-218. Balph discloses that when a first computer receives a message proposing that the first computer and a second computer connect, the first computer sends a message back to the second computer indicating that the first computer accepts the proposal to connect. *See* Ex. 1022 at cl. 1 (“A token bus local area network including a plurality of stations thereon incorporating a request with response mechanism comprising: a transmitting one of said stations for sending a request with response data frame to a predetermined receiving one of said stations on said network; said predetermined receiving station for responding to said transmitting station with a response data frame in response to said request with response data frame if said request with response mechanism thereof is enabled; wherein said predetermined receiving station comprises first means for detecting an enable bit and second means for detecting a pointer.”); Karger ¶¶ 187-189, ¶¶ 215-218.

With regards to claims 8 and 13, Rufino and Balph teach that, when two computers are connecting it was old and well known to send messages between the two computers where a connection invitation is sent and accepted. Karger ¶¶ 187-189, ¶¶ 215-218. It would have been obvious to use the Balph messaging protocol when implementing the connection method disclosed in Rufino, as addressed above. *Id.* Accordingly, by combining the above “request with response” method of Balph with Rufino’s method discussed in claims 7 and 12, in particular using

the “request with response” method for sending the connection-request message (set_successor packet) from the successor of the failed station (third computer), to the predecessor of the failed station (first computer), then the first computer will send a response message back to the third computer indicating that it has received the connection-request message (and accepts the proposal). *Id.* A POSITA would have been motivated to do so for any number of reasons that were also well known in the art, including, for example, maximizing the reliability and usefulness of the disclosed communications network and avoiding confusion on the network, as disclosed by Balph. *Id.* Indeed, any TCP connection would fulfill this limitation because of the way the TCP protocol works. *Id.* Accordingly, under Ground 3, a POSITA would have been motivated to combine the teachings of Shoubridge, Denes, Rufino, and Balph, which together disclose every limitation of claims 8 and 13. *Id.*

H. Ground 4: Claims 1-16

In Ground 1, Rufino is provided as an example of a well-known messaging technique to accomplish the disconnection steps disclosed by Denes. Karger ¶ 231. As discussed above, Rufino relates to a token ring, which is a 2-regular topology. *Id.* While it would be within the knowledge of a POSITA to expand the messaging techniques from a 2-regular topology to a 4-regular topology, a specific reference (Todd) that does so is provided in this ground (Ground 4) if the Board deems it

necessary. *Id.*

Todd is a printed publication and constitutes prior art under § 102(b) because it was publicly accessible no later than 1980. Todd is a research paper disseminated through an IEEE journal. Printed copies of the journal were available in more than 500 libraries. *See* Ex. 1004 at ¶ 129 and Attachments 18, 18a, and 18b. Further, it was indexed and cited by at least 5 other publications between 1996 and 1997. Thus, Todd was prior art under § 102(b).

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. The inclusion of claims 2-5, 7-10, and 12-16 in this ground is merely because they depend from independent claims 1, 6, and 11, and the analysis above does not change with the inclusion of Todd in this ground. *Id.*

VIII. CONCLUSION

For the foregoing reasons, *inter partes* review of claims 1-16 of the ’147 patent is respectfully requested. The required fee is being paid through PRPS.

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March 29, 2016

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(a), this is to certify that on March 29, 2016, I caused to be served a true and correct copy of the foregoing “[CORRECTED] PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 6,732,147” by EXPRESS MAIL on the alleged Patent Owner at the correspondence address of record for U.S. Patent No. 6,732,147, as follows:

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