UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC,
Petitioner

v.

KOVE IO, INC.,
Patent Owner

Case IPR2024-01019
U.S. Patent No. 7,814,170

DECLARATION OF DR. MICHAEL T. GOODRICH
IN SUPPORT OF PATENT OWNER'S PRELIMINARY RESPONSE

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I, Dr. Michael T. Goodrich, hereby declare as follows:

I. INTRODUCTION

1. I have been retained as an independent technical expert by Patent Owner Kove IO, Inc. ("Patent Owner" or "Kove") in this proceeding. Kove has asked me to provide my expert opinions concerning certain technical issues relating to Petitioner Google LLC.'s ("Petitioner" or "Google") petition for *inter partes* review of U.S. Patent 7,814,170 ("'170 patent") in Case No. IPR2018-01019 ("Petition") and the accompanying Declaration of Dr. Sandeep Chatterjee (Ex. 1002). I am being compensated for my work in this matter at my customary hourly rate. I am also reimbursed for any reasonable expenses associated with my work on this matter. My compensation is not contingent on the results of my study, the substance of my opinions, or the outcome of this matter.

II. MATERIALS CONSIDERED

2. In providing my expert opinions in this matter, I have reviewed:

- Ex. 1001: U.S. Patent No. 7,814,170 to Overton et al. ("the '170 patent")
- Ex. 1002: Declaration of Sandeep Chatterjee, Ph.D.
- Ex. 1003: Curriculum Vitae of Sandeep Chatterjee, Ph.D.
- Ex. 1004: Prosecution History of U.S. Patent No. 7,814,170
- Ex. 1005: WIPO Application No. 1997/043717 to Kahn et al.
- Ex. 1006: U.S. Patent No. 6,473,781 to Skagerwall et al.

- Ex. 1007: R. Vingralek, Distributed file organization with scalable cost/performance (1993)
- Ex. 1011: Japanese Patent Application Publication No. H09-231180 to Sato et al.
- Ex. 1015: M. C. Norrie et al., The Database Research Group at ETH Zurich, SIGMOD Record (March 1994)
- Ex. 1020: Declaration of Sylvia D. Hall-Ellis, Ph.D.
- Ex. 1021: U.S. Patent Application No. 09/111,896
- Ex. 1022: Amazon Web Services, Inc. v. Kove IO, Inc., IPR2020-00276, Paper 23 (June 16, 2020)
- Ex. 1023: Kove's Memorandum in Opposition to Amazon Web Services, Inc.'s Motion for Judgment on the Pleadings in Kove IO, Inc. v. Amazon Web Services, Inc., Case No. 1:18-cv-08175 (N.D. Ill. May 29, 2020)
- Ex. 1024: Memorandum Opinion and Order in Kove IO, Inc. v. Amazon Web Services, Inc., Case No. 1:18-cv-08175 (N.D. Ill. Dec. 17, 2021)
- Ex. 1025: Memorandum Opinion and Order in Kove IO, Inc. v. Amazon Web Services, Inc., Case No. 1:18-cv-08175 (N.D. Ill. Feb. 6, 2024)
- Ex. 1033: 2020 to 2023 Northern District of Illinois Orders Regarding Motions to Stay

- Ex. 1034: Agreed Order Setting Amended Patent Case Schedule in Kove IO, Inc. v. Google LLC, Case No. 1:23-cv-04244 (N.D. Ill. Feb. 20, 2024)
- Ex. 1035: Federal Court Management Statistics (December 2023)
- Ex. 1036: Memorandum by Director Vidal (June 21, 2022)
- Ex. 1037: Request for Ex Parte Reexamination of U.S. Patent No. 7,814,170 in Ex Parte Reexamination No. 90/019,035 (Nov. 19, 2021)
- Ex. 1038: Order Granting Request for Ex Parte Reexamination in Ex Parte Reexamination No. 90/019,035 (Jan. 12, 2022)
- Ex. 1039: Notice of Intent to Issue Ex Parte Reexamination Certificate in Ex Parte Reexamination No. 90/019,035 (Sept. 27, 2022)
- Ex. 1040: Request for Ex Parte Reexamination of U.S. Patent No. 7,814,170 in Ex Parte Reexamination No. 90/019,165 (Feb. 17, 2023)
- Ex. 1041: Order Granting Request for Ex Parte Reexamination in Ex Parte Reexamination No. 90/019,165 (Mar. 29, 2023)
- Ex. 1052: Order for Staying Discovery Process until July 15, 2024 in Kove IO, Inc. v. Google LLC, Case No. 1:23-cv-04244 (N.D. Ill. May 1, 2024)
- Ex. 1053: Northern District of Illinois Local Patent Rules
- Ex. 1055: Google's Motion to Stay and for Expedited Briefing Schedule in Kove IO, Inc. v. Google LLC, Case No. 1:23-cv-04244 (N.D. Ill. Apr. 30, 2024)

- Ex. 1056: Joseph B. Greene, Oracle8 Server Unleashed (1998)
- Ex. 1057: Joseph B. Greene, Oracle DBA Survival Guide (1995)
- Ex. 1058: Betty Salzberg, File Structures (1988)
- Ex. 1059: Andrew P. Black & Yeshayahu Artsy, Implementing Location Independent Invocation (1989)
- Ex. 2013: Joint Claim Construction Chart in *Kove IO, Inc. v. Amazon Web Services, Inc.*, Case No. 1:18-cv-08175 (N.D. Ill. May 29, 2020) (Dkt. 382)
- Ex. 2014: Reexam Decision in *Ex Parte* Reexamination No. 90/014,552

3. In forming the opinions set forth herein, I have considered: 1) The documents listed above; 2) my education, knowledge, skills, and experience in computer science, including, for example, the topics of networking, caching and mass data storage optimization, parallel and distributed computing, and high-performance computing; and 3) the level of skill of a person having ordinary skill in the art (POSITA) at the time of the date of invention of the ’170 patent.

III. BACKGROUND AND QUALIFICATIONS

4. Attached hereto as Appendix A is a true and correct copy of my Curriculum Vitae (“CV”). I received a Bachelor of Arts degree in Mathematics and Computer Science from Calvin University in 1983, a Master of Science in Computer Science from Purdue University in 1985, and a Ph.D. in Computer Science from Purdue University in 1987.

5. I am a Distinguished Professor in the Department of Computer Science at the University of California, Irvine, where I have been a faculty member since 2001. The Distinguished Professor title at University of California, Irvine is a campus-level distinction reserved for above-scale faculty who have achieved the highest levels of scholarship over the course of their careers and have earned national and international distinctions and honors of the highest level. I was a professor in the Department of Computer Science at Johns Hopkins University from 1987-2001.

6. I have authored and coauthored over 350 publications, including several widely adopted books, such as *Introduction to Computer Security* and *Algorithm Design and Applications*. My research includes contributions to data structures and algorithms, information security and privacy, networking, graph algorithms, computational geometry, distributed and parallel algorithms, and cloud security. For example, I have published research articles on topics in cloud computing and storage, hashing, data structures, and network and distributed computing. Using the indexing scheme of my CV, examples of such publications include P-3, P-5, B-1, B-3 through B-14, Ch-4, Ch-7, Ch-8, Ch-10, Ch-12, J-7, J-26, J-36, J-38, J-41, J-45, J-56, J-60, J-69, J-72, J-78, J-83, J-84, C-41, C-43, C-51, C-53, C-62, C-63, C-64, C-72, C-77, C-78, C-85, C-104, C-105, C-107, C-111, C-122, C-125, C-133, C-147, C-151, C-152, C-153, C-155, C-156, C-159, C-161, C-162, C-163, C-165, C-167, C-168, C-171, C-172, C-174, C-180, C-182, C-193, C-199,

C-200, C-202, C-207, C-209, and C-210. Further, I have published research articles on topics in audio and video creation, encoding, and distribution, as well as authoring research videos, including publications P-5, B-14, J-20, J-37, J-65, J-66, J-68, J-72, C-36, C-38, C-54, C-64, C-74, C-112, C-120, C-123, and C-159.

7. In addition, I have consulting experience in matters involving algorithms, cryptography, machine learning, digital rights management, computer security, networking, software, video distribution, and storage technologies.

8. I am a Fellow of the American Association for the Advancement of Science (AAAS), a Fulbright Scholar, a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), and a Fellow of the Association for Computing Machinery (ACM). I am a foreign member of the Royal Danish Academy of Science and Letters. I am also a recipient of the IEEE Computer Society Technical Achievement Award and the Pond Award for Excellence in Undergraduate Teaching.

9. My research has been supported by the Defense Advanced Research Projects Agency (DARPA), the National Science Foundation (NSF), the Office of Naval Research (ONR), the Army Research Office (ARO), and the National Security Agency (NSA). For example, I was co-principle investigator on an approximately $700K NSF grant funding (grants 6 and 19 in my CV) to build distributed data repositories and network query infrastructures for astrophysical data; a $350K NSF

grant to build out network connectivity and applications at Johns Hopkins University (CV, grant 11); a $900K grant from NSF to study high-bandwidth distributed computing (CV, grant 24); an approximately $500K grant from the ONR to study scalable methods for the analysis of network-based data (CV, grant 31); a $500K grant from NSF to study trustworthy cloud computing (CV, grant 33); an approximately $400K NSF grant to study privacy-preserving cloud computing (CV, grant 34); and an approximately $150K grant from NSF to study security protocols for advanced data structures (CV, grant 37).

10. I am a co-inventor on several U.S. patents, including U.S. Patent No. 7,257,711, "Efficient Authenticated Dictionaries with Skip Lists and Commutative Hashing," which discloses secure distributed data authentication schemes based on cryptographic hash functions and digital signatures; U.S. Patent No. 7,299,219, "High Refresh-Rate Retrieval of Freshly Published Content using Distributed Crawling," which discloses a technology for quickly retrieving website data that can change frequently, so as to be stored in a search engine; U.S. Patent No. 8,681,145, "Attribute Transfer Between Computer Models Including Identifying Isomorphic Regions in Polygonal Meshes," which teaches how to map one mesh-based computer model to another, with applications to animated video creation; and U.S. Patent No. 9,152,716, "Techniques for Verifying Search Results Over a Distributed

Collection," which discloses a system for searching the Internet so as to produce cryptographically verifiable search results that can be produced by a search engine.

11. I have taught courses at Johns Hopkins University, Brown University, and University of California, Irvine, at both the undergraduate and graduate levels. Topics of my courses have included computer security, algorithms, data structures, networking, algorithm engineering, computational geometry, computer graphics, and parallel processing. In addition, I have mentored 25 Ph.D. students over the years, who have written their Ph.D. theses on topics in algorithms, data structures, networking, parallel processing, and computer security and privacy.

12. I have served as an editor on several technical journals, including Computational Geometry: Theory and Applications, Journal of Computer & System Sciences, Journal of Graph Algorithms and Applications, Int. Journal of Computational Geometry & Applications, and Information Processing Letters. I have also served on many program committees (PCs) for top conferences and workshops in Computer Science, including serving as PC chair in several instances, including ACM Symposium on Computational Geometry (SoCG), ACM Symposium on Theory of Computing (STOC), Workshop/Symposium on Algorithms and Data Structures (WADS), Algorithm Engineering and Experimentation (ALENEX, which I co-founded with Dr. Catherine McGeoch in 1999), IEEE Symposium on Foundations of Computer Science (FOCS), ACM-

SIAM Symposium on Discrete Algorithms (SODA), International Symposium on Graph Drawing (GD), International Colloquium on Automata, Languages, and Programming (ICALP), ACM Conference on Computer and Communications Security (CCS), European Symposium on Algorithms (ESA), IEEE International Parallel and Distributed Processing, Symposium (IPDPS), ACM Symposium on Parallel Algorithms and Architectures (SPAA), ACM Symposium on Advances in Geographic Information Systems (GIS), IEEE Symposium on Security and Privacy (S&P), IEEE International Conference on Big Data, IEEE International Conference on Data Engineering (ICDE), and International Symposium on Algorithms and Computation (ISAAC).

IV. LEGAL PRINCIPLES APPLIED IN THIS DECLARATION

13. Counsel for Patent Owner has informed me of the legal principles that apply for purposes of my declaration.

A. Claim Construction

14. I understand that the words of a claim are generally given their ordinary and customary meaning, which I understand is the meaning that the term would have to the person of ordinary skill in the art in question at the time of the invention. I understand that the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification.

15. I understand that claim construction focuses on the "intrinsic evidence," which consists of the claims themselves, the specification, and the prosecution history. I understand that the claims can provide helpful context for how the claim term is used. I understand that the specification is highly relevant to the claim construction analysis and usually dispositive concerning the meaning of a claim term. I further understand, however, that it is inappropriate to import limitations from preferred embodiments recited in the specification into the claim language.

16. I understand that "extrinsic evidence" may also be considered when determining the meaning of a claim. I understand that there are different sources of extrinsic evidence, including dictionaries, inventor testimony, expert testimony, and learned treatises. I understand that intrinsic evidence is generally favored over extrinsic evidence, and that extrinsic evidence may not be used to contradict the meaning of the claim term when read in light of the intrinsic evidence.

B. Patentability

17. While I am not an attorney, I have been informed that a patent is presumed valid, and that each claim of a patent (whether an independent or dependent claim) is presumed valid independently of the validity of other claims. I understand that the Patent Office will find a patent claim unpatentable in an *inter partes* review if it concludes that it is more likely than not that the claim is unpatentable.

18. I understand that during an *inter partes* review proceeding, the standard for finding claims of an issued U.S. patent unpatentable is the "preponderance of the evidence standard."

19. I understand that issues of patentability relating to the claims of the '170 patent challenged in the Petition are to be considered under the relevant pre-AIA sections of Title 35 of the United States Code. I have been provided an understanding of those sections as noted below.

1. Anticipation

20. I understand for a claim to be unpatentable as anticipated under 35 U.S.C. § 102, every element and limitation of the claimed invention must be found in a single prior art reference, but also it must describe those elements arranged or combined as required in the claim. Although anticipation can be based on inherency, the missing disclosure must be necessarily present, not merely probably or possibly present, in the prior art.

21. I understand that a limitation can be inherently disclosed as a part of an anticipation analysis, but the standard for inherency is quite high and strict. Inherency may not be established by probabilities or possibilities. Inherency requires inevitability. I understand that to be inherent in a reference, the alleged limitation must be inevitable or necessarily present in the art. Such a showing must be accompanied by some evidence that makes clear that the missing matter alleged to

be inherent is necessarily present or the natural result flowing from the operation as taught would result in performance of the questioned function.

22. I understand that the Asserted Patents predate the America Invents Act and the pre-AIA version of 35 U.S.C. § 102 applies to any anticipation analysis. I have been instructed that under the pre-AIA version of the law, a claim is anticipated under § 102(a) only if the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent.

23. I have been instructed that under the pre-AIA law, a claim is anticipated under § 102(b) only if the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States.

24. Pre-AIA anticipation law also included a provision allowing for anticipation under § 102(e) where the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for the purposes of this subsection of an application filed in the United States only if the international application

designated the United States and was published under Article 21(2) of such treaty in the English language.

25. References that are ambiguous to the presence or description of a particular claim element do not anticipate a claim.

26. I also understand that for a reference to qualify as "prior art" for anticipation or obviousness, it must meet certain criteria. For example, I also understand that a prior art reference must be enabling. That is, the description in a prior art reference must be sufficient to enable a person of skill in the art at the time of the invention to make and use the claimed invention without undue experimentation. Several factors govern whether a disclosure would require undue experimentation. These are: (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.

2. Obviousness

27. I understand for a claim to be unpatentable as obvious under 35 U.S.C. § 103, the differences between the claimed invention and the prior art must be such that the claimed invention as a whole would have been obvious before the effective

filing date of the claimed invention to a person of ordinary skill in the art to which the claimed invention pertains.

28. I understand that in considering whether a claimed invention is obvious, one may consider whether there was a reason that would have prompted a person having ordinary skill in the art to which the claim invention pertains to combine known elements in a way the claimed invention does, taking into account such factors as: (1) whether the claimed invention was merely the predictable result of combining familiar prior art elements according to their known function(s); (2) whether the prior teaches or suggests the desirability of combining elements claimed in the invention; (3) whether prior art teaches away from combining elements in the claimed invention; and (4) whether a person having ordinary skill in the art had used a known technique to improve similar devices in the same way. I am informed that it is not sufficient to merely assert that it was obvious to try a combination of prior art elements in hindsight; knowledge of a problem and motivation to solve it are entirely different from a motivation to combine particular references.

29. I am informed that objective factors tending to show that a patent is not obvious include, among others: (1) evidence of copying the claimed invention(s); (2) long-felt but unmet need for the claimed invention(s); (3) commercial success of the claimed invention(s); (4) skepticism as to the solution; (5) industry acceptance of the claimed invention(s); and (6) praise by others for the claimed invention(s). I

understand all these factors may bear on whether a patent holder can overcome an initial impression of obviousness, subject to the requirement that the patent holder establish a nexus—in other words, a direct connection or link—between the adduced evidence and claimed invention's merits.

30. I understand that obviousness cannot be predicated on the mere identification in the prior art of individual components of claimed limitations. It is not appropriate to pick and choose among the individual elements of assorted prior art references to recreate the claimed invention. It is also not enough to show that the prior art references can be combined (i.e., are combinable). Rather, to prove obviousness, there must have been sufficient motivation at the time of the invention for a person of ordinary skill in the art to combine or modify the references in the manner proposed to arrive at the claimed invention. I also understand that motivation may not be gleaned from impermissible hindsight reasoning. For example, the reason to combine the prior art to arrive at the claimed invention cannot be based in whole or in part on what the patent in question teaches or discloses. I understand that the inquiry into secondary considerations is one way to test hindsight analysis.

31. I understand that it is Petitioner's burden to prove that a person of ordinary skill in the art would have been motivated to combine prior art references. I understand that the motivation to combine must be supported by evidence and

articulated explanation. When considering obviousness, I understand that it is insufficient to simply say that a skilled artisan, once presented with a combination of references, would have understood that they could be combined.

32. Rather, Petitioner must show that a person of ordinary skill in the art would have been motivated to combine or modify the prior art to arrive at the claimed invention. Conclusory statements alone are insufficient, and any obviousness analysis must be supported by a reasoned explanation as to why a person of ordinary skill in the art would have been motivated to combine the prior art. For example, "common sense" or "intuition" alone cannot support a motivation to combine without explaining why they would lead a person of ordinary skill in the art to solve the problem at hand with the particular elements of the claimed invention at the time of invention.

33. I understand that there is no motivation to combine references when a feature from one reference would be redundant or superfluous in the other reference. I further understand that obviousness cannot be found in an absence of a specific explanation as to why a particular combination is not redundant.

34. I understand that there is no motivation to combine when the combination would be inoperable and, thus, "teaches away" from the combination. To the extent that references teach away from the claimed invention, they cannot establish obviousness. Prior art teaches away from an invention when a person of

ordinary skill would be discouraged or diverted from following the path leading to the invention. I also understand that if a proposed combination would require modification of prior art and that modification would render the prior art unsatisfactory for its intended purpose, then there is no motivation to make the proposed combination and modification. I also understand that when prior art teaches away from combining prior art references, the discovery of a successful way to combine them is unlikely to be obvious.

35. I understand that to determine the scope and content of the prior art, one must consider whether the prior art was reasonably relevant to the particular problem the inventors faced in making the claimed invention.

36. To determine whether any material differences existed between the scope and content of the prior art and each asserted claim, one must consider the claimed invention as a whole to determine whether or not the claim would have been obvious in light of the prior art. If the prior art discloses all the elements in separate references, I must consider whether it would have been obvious to combine those references. I understand that a claim is not obvious just because all elements of a claim already existed.

37. I understand that a motivation to conduct further testing or research that may lead to the claimed invention does not necessarily render a claim obvious. I further understand that an invention is not necessarily rendered obvious simply

because a party asserts it was obvious to try a certain combination. Rather, the question is whether a person of ordinary skill would have had good reason to pursue the known options within his or her technical grasp, and whether such pursuit would have led to anticipated success. I understand that an invention would not have been obvious to try to a person or ordinary skill in the art if any of those findings cannot be made.

V. BACKGROUND

A. Overview of the ’170 Patent

38. The ’170 patent describes an innovative approach to efficiently manage and retrieve data stored across a network of distributed data storage locations. In large-scale distributed data environments, data can reside in multiple repositories, complicating the process of locating and retrieving information related to specific entities. The ’170 patent teaches techniques to efficiently separate the “where” (determining the appropriate data storage server(s) to query) from the “what” (the data content itself), thereby streamlining data access.

39. As an example, the ‘170 patent teaches that data entities are stored in data repositories, where each data entity is associated with a unique identifier. Ex. 1001, 4:10-12, 35-37. (“An ‘identifier string’ or an ‘identifier’ is a unique string with which zero or more location strings are associated in an NDTP server. … NDTP defines an entity key (or “identifier”) as a unique string used to refer to an entity

about which a distributed query is performed"). A network of data location servers stores the mappings between identifiers and the locations of the corresponding data in the data repositories. *See, e.g., id.,* 3:19-21 (NDTP servers "maintain a mapping between entity identifiers and data locations.") The patent further teaches that it is expected that the list of data location servers may change over time. *Id.*, 16:22-27.

40. In the following, I briefly summarize certain embodiments relating to the claims of the '170 patent.

B. Overview of the Claims

41. Distributed data collection involves storing data stored and retrieved among multiple databases or data repositories connected by a network. Conventional distributed data collection environments maintained a static relationship of data and its location. In this regard, conventional distributed data collection environments maintained a static relationship of data and its location. Every time data moved from one location to the next, all of the systems that maintained the static relationship had to be updated. As a result, while conventional distributed data collection environments allowed for dispersed storage, doing so made reliably locating and retrieving the data challenging, particularly where data is added or removed dynamically. *Id*., 1:37-43.

42. The '170 patent addresses the issues with conventional systems, which were fundamentally limited in the types of searches that could be performed and the

forms of data returned based on the search. *Id.*, 1:44-47. For example, the '170 patent states, "One example is where a client requests files based on a subject, like a person's name. In the search results, therefore, only text files of peoples' names may be retrieved. Another problem in current retrieval systems is that the client may receive text and image files in the search results, but could not seamlessly access the image files. Yet another problem in current retrieval systems is that video and sound files related to the request may not even be found in the search results. For example, a doctor might be able to retrieve medical records on a specific patient, but cannot view an MRI or X-Ray results associated with that record." *Id.*, 1:47-57.

43. The '170 patent addresses the issues with conventional systems in two ways. First, the '170 patent teaches separating the data location information from the data itself. *See e.g., id.*, 1:64-67, 20:17-21, Fig. 11. Second, the '170 patent teaches organizing data location information in location servers such that every location server is configured to either identify another location server that has the requested information or enable the client device to calculate the location of the data location information (if the first location server does not itself have the requested information – if it does, it simply returns that to the client). This is claimed by claims 1, 6, and 15.

1. Claim 1

44. Claim 1 of the '170 patent (Ex. 1001) recites:

1. A system for managing data stored in a distributed network, the system comprising:

[1.a] a data repository configured to store a data entity, wherein an identifier string identifies the data entity; and

[1.b] a data location server network comprising a plurality of data location servers, wherein data location information for a plurality of data entities is stored in the data location server network, at least one of the plurality of data location servers includes location information associated with the identifier string, each one of the plurality of data location servers comprises a processor and a portion of the data location information, the portion of the data location information included in a corresponding one of the data location servers is based on a hash function used to organize the data location information across the plurality of data location servers, and each one of the data location servers is configured to determine the at least one of the plurality of data location servers based on the hash function applied to the identifier string.

The ’170 patent specification describes embodiments of a network distributed tracking protocol (NDTP). Fig. 11 of the ’170 patent, reproduced below, shows a

NDTP system configuration for an exemplary embodiment of the structure of the NDTP system:

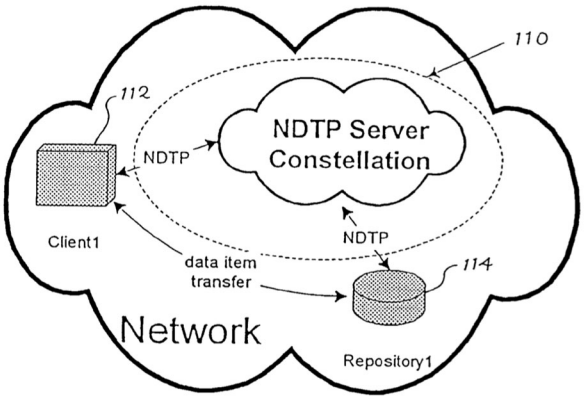


Fig. 11 NDTP Server Constellation Context

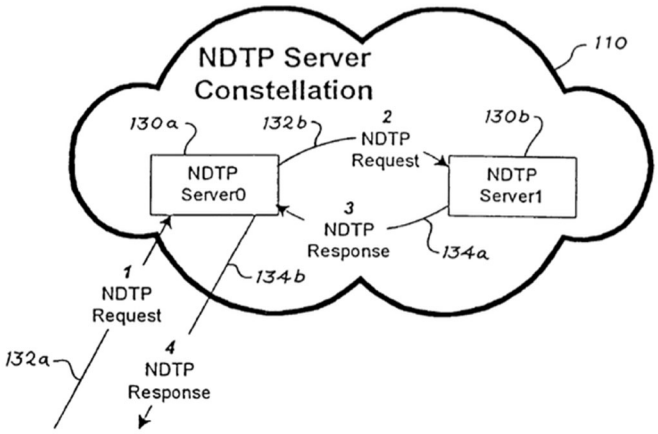
45. The '170 patent specification teaches that a network distributed tracking protocol (NDTP) system with features that includes, for example, the following features, among others:

- A data repository that stores data entities, where each individual entity is identified by a unique identifier string. *See id.*., 5:33-35 ("NDTP defines an entity key (or 'identifier') as a unique string used to refer to an entity about which a distributed query is performed."), 5:36-38 ("The NDTP server treats the entity key as an unstructured stream of octets, which is assumed to be unique to a particular entity."), 4:43-45 ("[T]he NDTP entity key might be a unique customer identifier, for example, a Social Security Number. . . .").

- A data location server network with a plurality of data location servers that store the mapping between identifier strings and the locations of the corresponding data in the data repositories, where the data location information is distributed across the location servers based on a hash function. *See id.*, 20:23-25 ("NDTP servers maintain a mapping between entity identifiers and data locations."), 20:40-45 ("Those skilled in the art will note that the invention provides for the management and manipulation of indices and their associated relationships. Even more importantly, it is the manipulation of dynamic and spontaneous relationships between indices and locations, not the indices and locations, that is the core significance.").
- The use of a hash function to index and organize the mapping of identifier strings to their corresponding data locations. *See id.*, 15:12-49. The '170 patent teaches that utilizing the hash function for organizing data location information makes the location server system scalable, even when the system must store and manage extremely large numbers of data. *Id.*, 19:6-8.
- The ability for every data location server in the network to apply the hash function to an identifier string to precisely determine where to route mapping queries. As explained above, the '170 patent teaches using a hash function to distribute the location information across distributed NDTP servers. Notably, the '170 patent further teaches that the hash function and, if used, hash table,

are specifically designed to correctly identify the necessary location server for a client request. *See, e.g., id.*, 15:40-42.

46. The '170 patent describes embodiments in which each NDTP server is able to apply the hash function to identify the server that contains requested data location information. Fig. 13, for example, shows a "Server-Centric Constellation" embodiment in which the first NDTP server (labeled "NDTP Server0") is able to direct an incoming NDTP request to the correct second server ("NDTP Server1"), which subsequently returns an NDTP response that can be returned to the querying client. *Id.*, 18:33-41. Fig. 13 is reproduced below:



NDTP Server-Centric Constellation

Id., Fig. 13.

2. Claims 6 and 15

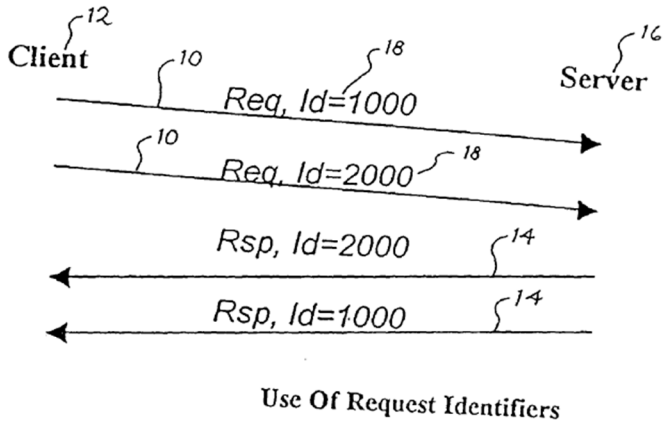
47. Claims 6-17 (including independent claims 6 and 15 and their dependent claims) relate to the ’170 patent’s teaching a distributed location server system configuration in which, if a location server receives a location query but does not have desired location information, that queried location server returns a “redirect message” to the client, which includes an identification of the location server that does contain the location information. For example, claim 6 states:

> **6.** A system for managing data location information and providing the data location information in response to location queries, the system comprising:
>
> **[6.a]** a location server configured to receive a location addition request, the location addition request formatted in conformance with a transfer protocol, the location addition request comprising an identifier and at least one location to associate with the identifier, wherein the identifier identifies an entity and wherein each of the at least one location specifies a location of data in a network pertaining to the entity;
>
> **[6.b]** wherein the location server includes a processor; and
>
> **[6.c]** programming logic stored on the location server, wherein the programming logic is configured to return, in response to a location query related to a desired entity, a location message, the location message in conformance with the transfer protocol and comprising at least one location

> associated with the desired entity, wherein the programming logic is further configured to return the location message if the location server contains location information for the desired entity, and *wherein the programming logic is further configured to return a redirect message if the location server lacks the location information for the desired entity, the redirect message comprising a list of at least one other location server known to have the location information for the desired entity*

The portion of element [6.c] regarding a "redirect message" is substantively representative of claim 15 as well and is the focus of the issues in dispute for these claims. *See* Ex.1001, 22:44-48 ("sending a redirect message to the client in response to determining the one of the plurality of location servers fails to include the location information, ***the redirect message identifying which of the plurality of location servers includes the location information***.") (emphasis added).

48. The '170 patent teaches several ways clients can request location information associated with an identifier string, where each request has a corresponding response message returned by the server receiving the request. *Id*., 6:32-34. An example of NDTP protocol requests and responses are depicted in Figure 1:

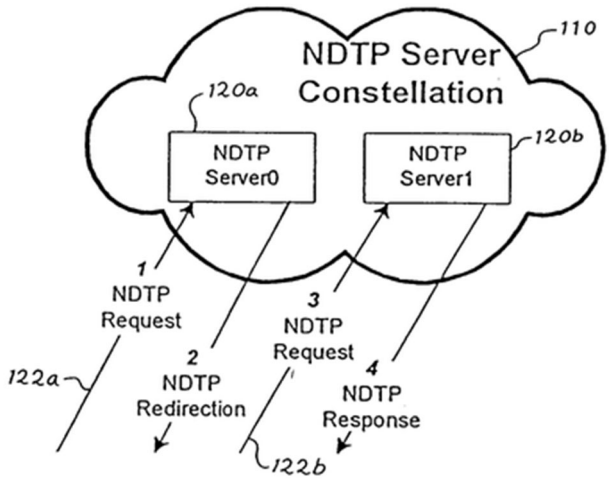


Use Of Request Identifiers

Fig. 1

Id., Fig. 1.

49. The ’170 patent teaches an implementation illustrated by exemplary embodiments that follow a system configuration illustrated in “NDTP Client-Centric Constellation” schematic Fig. 12, which is reproduced below:



NDTP Client-Centric Constellation

Fig. 12

50. As Fig. 12 shows, the '170 patent teaches that a client may send a request with an identifier (labeled "1 NTDP Request" in Fig. 12) to a location server ("NDTP Server0") in the network. If that server does not have the requested data, then the queried server ("NDTP Server0") will send an "NDTP Redirection" response, or ***redirect message*** ("2 NDTP Redirection") back to the client. The client applies the information contained in the NDTP Redirection response ("2 NDTP Redirection") to redirect the request for location information corresponding to the identifier to another server ("NDTP Server1") that does, in fact, have the requested, which sends the response ("4 NDTP Response") back to the client. *Id.*, 17:9-21. As the '170 patent's specification discloses:

> [the] NDTP redirection mechanism uses a NDTP_RDR_RSP message to indicate that the server **120** *a* to which the NDTP request **122** *a* was directed does not contain any of the location strings associated with the identifier string supplied in the NDTP request **122** *a*. **The NDTP_RDR_RSP message contains all the information required for the originator of the NDTP request 122 *a* [i.e., the client] to reissue the original NDTP request 122 *b* to a different NDTP server 120 *b* that does have location strings associated with the identifier string supplied in the NDTP request 122 *b*.**

51. *Id.*, 17:61-18:3. The specification repeatedly and consistently teaches a POSITA that a client may query a server in the network, and that queried server will provide a response back to the client. *See id.*, 2:38:42; 2:62-65; 3:3-6; 4:17-20; 4:31-35; 6:50-7:4; 9:41-46; 11:66-12:2; 13:4-8; 14:63-67; 17:3-6; 17:31-37; 17:65-18:3; 18:36-48. As a result, a POSITA would understand that the '170 patent teaches that responses to client queries always come from the location server to which the request for location information is sent, i.e., the queried server. As a result, client requests can be efficiently serviced by a distributed network of location servers that may be dynamically changing.

52. Claims 6 and 15 both include the "redirect message" limitation. Claim 6 provides for a system that requires "programming logic" stored on a location server, that is configured "to return a ***redirect message*** if the location server lacks the location information for the desired entity, the redirect message comprising a list of at least one other location server known to have the location information for the desired entity." *Id.*, 21:52-57. Similarly, the method of claim 15 requires, "sending a ***redirect message*** to the client in response to determining the one of the plurality of location servers fails to include the location information, the redirect message identifying which of the plurality of location servers includes the location information." *Id.*, 22:44-48.

53. The ’170 patent describes two different exemplary ways in which the information for client redirection can be provided in a redirect message: (1) The redirect message can include a data location server table, and in which case, the patent specification that the client can then uses a hash function on the identifier string and use the server table to calculate the location of the correct server. *See id.*, 15:4-15:49. (2) The redirect message can include a transmitted function that the client applies to the identifier string to calculate the location (e.g., URL) of the correct data location server. *See id.*, 15:50-16:20. Notably, the specification teaches that in both mechanisms, it is the data location server that received the (incorrect) query that directly sends the redirect message to the client. *Id.*, 14:63-15:3, 18:32-19:4.

54. A POSITA’s understanding of claim element [6.c], including client redirection via information for the redirect message, and that the redirect message is sent by the queried (incorrect) server, is further reinforced by the prosecution history of a related patent. The ’170 patent is a continuation of the application that issued as the ’640 patent, which has a very similar specification and has claims that similar “redirect message” claims. When the Examiner issued the decision confirming the patentability of the “redirect message”-based claims in ‘640 patent Ex Parte Reexamination No. 90/014,552, the Examiner’s written decision pointed out the prosecution history of the ’640 patent:

This limitation was also the focus of the Applicant's remarks filed in response to the 2/9/05 Office action. The Applicant argued, "Referring to claim 24, when a user enters a request at a client for data at a first client, the data query includes an identifier string (e.g. a file name or URI) and expects to receive information (a location string) on where the data corresponding to that filename resides. ...During this navigation process, if a data location server does not possess the sought after location string, it transmits a redirect message back along the communication path the data location request traveled to the first client. The redirect message that is sent back to the first server contains information with which the first client is configured to determine a location of a second data location server that does contain the sought after location string. In other words, the redirect message allows the first server to calculate a new data location server address so that the first server "redirects" its query to the right data location server.

...Similarly, the method of claim 33 also includes includes the feature of redirection, however claim 33 addresses a more simplified scenario such as shown in FIG. 12, where there are not necessarily any intervening devices between the client and the data location servers.

> New independent claims 41, and 42 relate to system configurations adapted to incorporating software instructions implementing the redirection process."

Ex. 2014, 13-14. As such, the reexamination proceedings and prosecution history further confirm a POSITA's understanding that the '170 patent's redirect message provides the client the information necessary to determine the data location server expected to have the sought-after information and redirect its query to that server.

C. Overview of Kahn

55. Kahn" is WIPO Application No. 1997/043717 to Kahn et al. Kahn discloses a system for managing digital objects in a network, where the objects are stored at server locations accessible in the network using a storage technique that renders the digital objects secure against unauthorized access. Ex. 1005, 3:15-19. Kahn discloses that a "digital object" is "any set of sequences of bits or digits and an associated unique identifier which we call a 'handle'." *Id*., 1:10-12. Kahn further discloses, "the pointer to the object (versus identifier information for the object) is stored in multiple servers on the network" and "[t]he identifiers are generated in a manner to distribute the pointer information with the unique identifier information) relatively evenly among the servers, using a hashing algorithm." *Id*., 4:18-22.

56. Kahn describes that handle management systems 54 are "used to find the location of digital objects" and "[a] handle for an object may be associated with

zero or more object pointers," which "contain location information for locating digital objects." *Id*., 28:29-34. In Kahn, "[h]andle servers 58 process handle query requests," such that a handle server accepts a handle as input and returns a list of pointers associated with the handle, where each pointer comprises a domain name of a storage system (repository) for the associated digital object. *Id*., 29:5-12.

57. Separate to handle servers 58, Kahn describes a "handle directory server", which is also referred to as a "handle server directory 59." *Id*., 29:18-20, 38:9-11. The handle server directory 59 holds a table 149 that associates hash ranges 150 with domain names of handle servers 58. *Id*., 46:22-24, Fig. 7. A client in Kahn downloads the table that associates hash ranges with handle server domain names from the handle server directory. *Id*., 46:29-32. A client uses this table to determine which handle server 58 to send a request for a list of pointers associated with a handle. *Id*., 47:1-5. The client then sends a handle request to the handle server 58 and if the handle server finds the associated list of points for the handle, it returns it. *Id*., 47:10-13. But if the handle was sent to the wrong handle server 58, it returns a "not-responsible-for-handle" message. At that point, the client system can download the hash range/handle-server-domain-name table from the handle server directory 59 again and attempt the mapping again. *Id*., 47:13-18.

D. Overview of Vingralek

58. Vingralek is a technical report titled "Distributed file organization with scalable cost/performance".

59. Vingralek presents a distributed file organization system for record-structured, disk-resident files with key-based exact-match access. The file is organized into buckets that are spread across multiple servers, where a server may hold multiple buckets. Client requests are serviced by mapping keys onto buckets and looking up the corresponding server in an address table, which is stored at the client.

60. In Vingralek's system, there is an indirection between bucket numbers and server numbers, so that multiple buckets can be assigned to the same server. This indirection is implemented by an address table, and updates to the address table are propagated to clients and other servers in a deferred manner. *Id*. at 5. Vingralek also says, "Hashing is used merely to distribute keys across buckets. The internal organization of buckets can be chosen freely, and may vary between servers." *Id*. at 7.

61. Vingralek discloses a key-value store with a process for looking up the value associated with a key such that when a client *c* invokes an operation on key *K* (e.g., to retrieve the record(s) with key *K*), it applies to *K* the hash functions *h* until it finds in its copy of the address table a server where *K* should reside and *c* sends *K*

to that server. When a server s in Vingralek receives a key *K* from the client, it applies to *K* the hash functions *h* until it finds in its copy of the address table a server *s′* where *K* should reside as far as s is concerned. If *K* does belong to the server that received it (i.e., if *s* = *s′*), the server performs the requested operation. However, if *K* was sent to the wrong server, the server forwards it to *s′*, and updates the client's view with its file level *L*, and its address table. Eventually, *K* is received by the correct server and the client operation is executed. Further, clients gradually bring address table up-to-date, but the number of iterations required to do this can be unbounded. *Id*. at 9-10.

VI. PRIORITY DATE OF THE ’170 PATENT

62. For purposes of this proceeding, I have been asked to assume the priority date of the ’170 patent is September 14, 1999, which is the earliest possible priority date.

VII. LEVEL OF ORDINARY SKILL

63. In my opinion, a personal of ordinary skill in the art (POSA or POSITA) with respect to the ’170 patent as of the priority date would have a Bachelor’s degree in Computer Science (or equivalent), and one to two years of industry experience in software engineering, networking, or data storage and retrieval. An advanced degree in Computer Science, or equivalent, could be substituted for one to two years of industry experience in software engineering, networking, or data storage and

retrieval. Further, four or more years of industry experience in software engineering, networking, or data storage and retrieval could be substituted for a bachelor's degree in computer science and one to two years of industry experience in software engineering, networking, or data storage and retrieval. For instance, the '170 Patent states that its "invention relates generally to the storage and retrieval of information, and in particular, to a system and method for managing global search and retrieval of information across a network." Ex. 1001, 1:29-33.

64. I have reviewed Dr. Chatterjee's description of the level of ordinary skill in the art with respect to the '170 patent. Ex. 1002, ¶ 20. I disagree.

65. However, my opinions in this Declaration regarding the '170 patent and the prior art would not differ under either the perspective of a POSITA as I have defined above or under Dr. Chatterjee's definition at the time of the invention of the '170 patent.

VIII. CLAIM CONSTRUCTION

66. I have been asked to apply the constructions of certain claim terms presented below. I have applied these constructions in my analysis and in forming my opinions set forth in this Declaration. For other claim terms, I have been asked to apply their plain and ordinary meaning to a POSITA, at the time of the invention, in view of the language of the claims, specification, and prosecution history. The relevant claim constructions are as follows:

’170 Patent Terms	AWS Proceeding/IPR Construction
identifier identification string identifier string	a unique encoding that identifies an individual entity, and with which zero or more data location specifiers/strings are associated in a location server
location information	information pertaining to one or more locations of data and/or the identities of one or more location servers
location server	a network-attached component that maintains a set of identifier/location mappings that are modified or returned in response to location request messages from clients
client	a network-attached component (which may be software or hardware) that initiates update or lookup of identifier/location mappings from a location server with location request messages
plurality of location servers	location servers in non-hierarchical structures

	(EX1025, 19)

IX. CLAIM 1 - NOT OBVIOUS TO COMBINE KAHN WITH VINGRALEK

67. I have been asked to evaluate whether Kahn in view of Vingralek renders the limitation "each one of the data location servers is configured to determine the at least one of the plurality of data location servers [that includes location information associated with the identifier string] based on the hash function applied to the identifier string" recited in claim 1 of the '170 patent obvious.

68. This element requires a network of data location servers and "at least one" of those servers must contain "location information associated with" a particular identifier. The element also requires that each server in the network must be "configured to determine" which of the servers among them is the target server.

69. Petitioner alleges that Kahn teaches the "determin[ing] the at least one of the plurality of data location servers based on the hash function applied to the identifier string" portion of the limitation. Pet., 22. Petitioner turns to Vingralek to teach "*each one of the data location servers is configured to*" portion of the limitation. *Id.*, 25. Petitioner argues that a POSITA "would have been motivated and found it obvious to include this feature in view of Vingralek". *Id*. In my opinion, Kahn in view of Vingralek does not render this limitation obvious.

A. "*configured to determine the at least one of the plurality of data location servers based on the hash function applied to the identifier string*"

70. As I indicated above, Kahn teaches a "handle management system" that is "used to find the location of digital objects and the locations of each object's RMS [rights management system]." Ex. 1005, 28:29-34. Kahn teaches that a client sends a handle query request to a handle server in the handle management system. *Id.*, 29:5-13, Fig. 8 (annotated below).

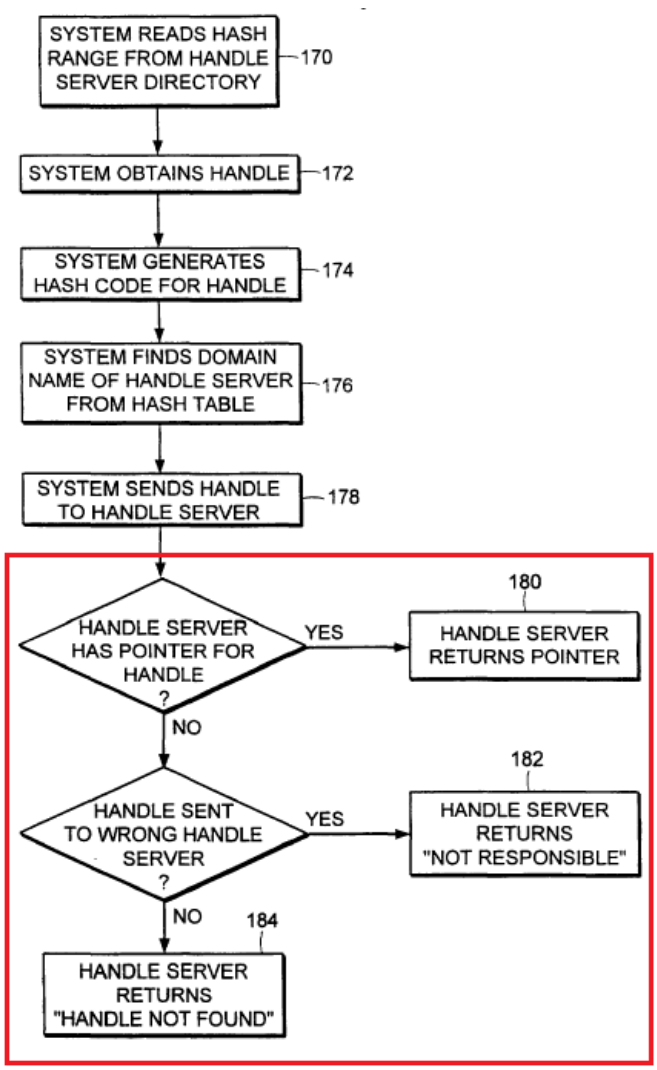


FIG. 8

In Kahn, "[h]andle servers 58 process handle query requests," such that a handle server accepts a handle as input and returns a list of pointers associated with the handle, where each pointer comprises a domain name of a storage system (repository) for the associated digital object. *Id*., 29:5-12. As shown in Fig. 8, if the handle server has the requested information, it returns that information to the client (box 180). *Id.*, 47:11-21; Fig. 8. If the handle server does not have the requested information, it transmits either a "not responsible" or a "handle not found" message back to the client (boxes 182, 184, respectively). *Id.* If the client receives the "not-responsible" message, the client can "download the hash range/handle-server-domain-name- table from the handle server directory again and attempt the mapping again." *Id*.

71. The claim requires that each of the location servers be able to determine which location server in its network of location servers is the location server storing the sought-after information, ***no matter which location server that is.*** But Kahn's handle servers cannot do so. That is, a given handle server can only resolve whether it has the requested information. If the queried server does not have the requested information, it is not configured to determine which server does. Contrary to Petitioner's assertion, the handle server being configured to determine that the sought-after information "is indeed located in the queried handle server" does not satisfy the claim requirements. Pet., 25. Instead, Kahn's handle servers must be

configured to determine which server in the network is the server storing the sought-after information, even if it is not the queried server. Kahn does not teach this nor does Petitioner address this deficiency.

B. No Motivation to Modify Kahn with Vingralek

72. As I indicated above, Petitioner relies on Vingralek to allegedly teach "each one of the data location servers is configured to …" portion of the limitation. Pet., 25. Petitioner states a POSITA would be motivated to modify Kahn with Vingralek because both Kahn and Vingralek disclose that "client and handle server store copies of the hash table", a POSITA would have been motivated to "consider the teachings of Vingralek when implementing" Kahn. Pet., 29. Petitioner further alleges that modifying Kahn in view of Vingralek would "have been beneficial as it would have reduced the frequency of communications to a client and/or the use of the client's computational resources, particularly in situations where the client has limited communication bandwidth and/or limited computational resources (e.g., resources required for calculating the correct handle server)." *Id*. Both assertions are incorrect.

1. Kahn's "handle servers" do not store hash tables

73. Petitioner and Dr. Chatterjee points to the following citations in Kahn's in support of the assertion that Kahn's "handle servers store copies the hash table": Ex. 1005, 38:9-17 and 46:29-32 in support. This is incorrect. The first citation says:

> As seen in Fig. 34, the handle server system 1230 includes handle servers 1232 and handle directory servers 1234 located at certain well known locations. **The directory servers will maintain a table of network addresses of handle servers (generally, each handle server will contain such a directory).** This table will 15 generally be downloaded by each participating site frequently enough to be "acceptably" up-to-date at all times.

Ex. 1005, 38:9-17 (emphasis added).

74. Here, Kahn also describes each handle server contains a "directory" that is a "table of network address of handle servers." However, this directory is not a hash table. Instead, this table maps domain names of handle servers to their network addresses, and Kahn acknowledges that this table must be downloaded frequently enough to be "acceptably" up to date at all times. *Id*., 38:9-17, Fig. 34. For example, Kahn consistently distinguishes domain names from network (IP) addresses. *See*, *e.g.*, *id*., 29:5-28, 35:18-19, 39:18-23, 44:30-32, 45:5-21, 46:22-24, 46:29-32, 47:1-21, 56:27-57:2.

75. The "directory" that each handle server generally contains is the "table of network address of handle servers." This is not a hash table. The second citation says:

> In a first step 170, **a client system downloads the table that associates hash ranges** with handle server domain names **from the handle server directory** for future use.

Id., 46:29-32 (emphasis added).

76. Here, Kahn describes that there is a table that associates hash ranges with handle server domain names. However, this table originates at a handle directory server, which is distinct from a handle server. *See* §IX.A, B. Kahn also teaches in this disclosure from its specification that the client downloads such a table, rather than a handle server. In full, Kahn does not disclose that the "handle server stores a copy of the hash table" at any point in its specification.

2. A POSITA Would Not Modify Kahn with Vingralek Based on Petitioner's Alleged Motivation

77. Petitioner alleges that a POSITA would have been motivated to modify Kahn because it would have met Vingralek's goal of reducing communication overhead. Pet., 29. A POSITA would understand that claim 1 does not concern communication overhead. As such, a POSITA would not have been motivated to modify Kahn to seek a solution unrelated to claim 1.

78. Additionally, Petitioner's alleged combination of Kahn and Vingralek would not "reduce the frequency of communications to a client and/or the use of the client's computational resources." Pet., 29. Both Kahn and Vingralek teach that a

client queries the incorrect server when it has an incorrect or stale address table. EX1005, 47; EX1007, 9-10. As a result, the client downloads/receives a less stale version of the hash table or address table. This means that the client would still need to communicate with the servers to receive a less stale of a table. Otherwise, the client will always query an incorrect server.

79. A POSITA would understand that Petitioner's alleged combination also requires a lot of modifications to Kahn. These modification would create an extensive burden on the handle servers. Particularly, as indicated above, none of Kahn's handle servers are configured to determine which other handle server is storing the sought-after information. *See supra* §IX.A. If Kahn were to be modified in the manner Petitioner suggests, each handle server be configured to transmit the hash table to the client because Kahn's handle servers do not store copies of the "hash range/handle-server-domain-name table" (i.e., an alleged hash table). *See supra* §IX.B.1. However, a POSITA would understand that to maintain an accurate, current, and consistent hash table in the handle servers to achieve the claim's requirement would require frequent updates and downloads of the hash table by each handle server to maintain sufficient synchronization. *See, e.g.,* EX1005*,* 38:14-17. Therefore, a POSITA would understand that, far from reducing communication overhead with such an extensive modification and requiring continuous

synchronicity between servers in a distributed network would result in an increasing workload and burden on the handle servers of Kahn's existing system.

80. A POSITA would understand that Kahn already provides a solution for retrieving an updated address table (i.e., by downloading it from the hash server directory). EX1005, 46:29-32. Petitioner or Dr. Chatterjee do not provide any evidence or analysis of why a skilled artisan would have discarded Kahn's approach in favor of Vingralek's error-prone system. Incorporating Vingralek's scheme into Kahn would introduce additional complexity and inefficiency, where there would need to be multiple client redirects due to inaccurate address tables leading to the identification of incorrect servers that do not contain requested information.

X. KAHN WITH VINGRALEK DOES NOT TEACH THE "REDIRECT MESSAGE" OF CLAIMS 6 AND 15

81. I have been asked to analyze Google's asserted combination of the Kahn and Vingralek references, which Google alleges renders the claims obvious, specifically with respect to teaching the "redirect message"-related claim limitations in claims 6 and 15. Claims 6 and 15 require the limitations require that: *(i)* a redirect message is returned to the client by the location server receiving the location query if that queried location server does not have the requested information and *(ii)* the redirect message must identify a different location server containing the requested information.

82. Petitioner breaks the claim limitation into two portions and alleges that Kahn alone discloses the "redirect message," and Kahn combined with Vingralek teaches "comprising a list of at least one other location server known to have the location information for the desired entity."[1] Pet., 46-47. Both of Petitioner's assertions are incorrect.

A. Kahn does not teach the claimed "redirect message"

83. Petitioner's theory the "redirect message" to Kahn's return of a "not-responsible-for-handle" message. As described above, Kahn teaches that if the handle server does not have the requested information, it transmits back to the client either a "not responsible" or "handle not found" message. *See* §V.C. This is illustrated in Ex. 1005, Fig. 8, which is reproduced and further annotated below to highlight the points at which the handle server returns either a pointer corresponding to the handle in the request (if the server contains it) or sends a "not-responsible-for-handle" message.

[1] Petitioner provides the same arguments for claim 15. Pet., 59-62.

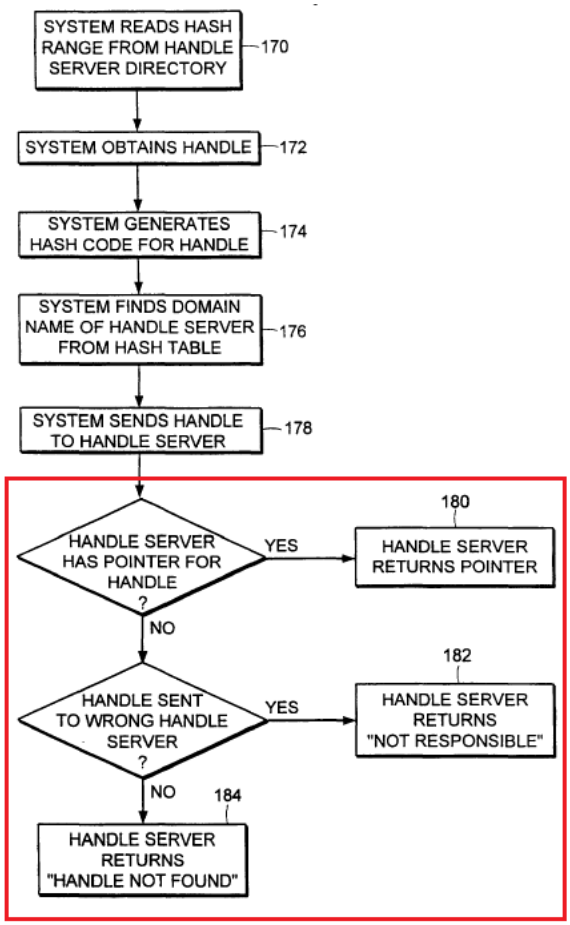


FIG. 8

84. The "not-responsible-for-handle" message cannot be the "redirect message" required by the claims and described by the specification. There is no redirection of the client in the "not-responsible-for-handle" message. Instead, the "not-responsible-for-handle" message merely provides the information that the server does not contain the requested pointers for the requested handle, and nothing else. The "not-responsible-for-handle" message does not redirect the client to any other handle server. Specifically, the "not-responsible-for-handle" message does not

"contain information for use by the client to calculate a location of a second data location server," as the claim elements at issue provide that a redirect message must.

85. I have also been asked to evaluate the theory that Kove's complaint filed against Google in a parallel patent infringement case (Ex. 1019) "reads the 'redirect message' on a cache miss response due to stale or incorrect location information." To the extent that Google is saying that a cache miss is inherently a redirect message, I disagree that a cache miss response is inherently a redirect message, and I disagree that such an argument is implied by Kove's initial complaint. The asserted claims are clear that the redirect message is not ***any*** type of redirect message, cache miss message, or other type of "not found" message. Instead, the claimed redirect message must be "containing information for use by the first client to calculate a location of a second data location server." This is evident from the description of using a "location algorithm which calculates a location of a second data location server," which suggests the redirect message contains information used for this calculation, as required by the claims. *See* Ex. 1001, cls. 10, 17, 18. The claims require that the redirect message must "contain information for use by the client to calculate" the location of the correct data location server. Kahn's "not responsible" message does not contain any such information.

B. "redirect message comprising a list of at least one other location server known to have the location information for the desired entity"

86. Kahn also does not teach a handle server sending a "list" of other handle servers known to have the requested information back to the client following a failed query. As an initial matter, Kahn discloses a "handle directory server", which is also referred to as a "handle server directory." Ex. 1005, 29:18-20 ("The handle server directory 59 allows users to find the correct handle server for processing a given handle"), 38:9-11 ("As seen in Fig. 34, the handle server system 1230 includes handle servers 1232 and handle directory servers 1234 located at certain well known locations.") , 46:29-32 ("In a first step 170, a client system downloads the table that associates hash ranges with handle server domain names from the handle server directory for future use."). The "handle directory server" and "handle server" are different servers, for example, as illustrated in Fig. 34, which is annotated below to identify the "handle servers 1232" and "handle directory servers 1234" in "handle server system 1230" (*id.*, 38:9-11):

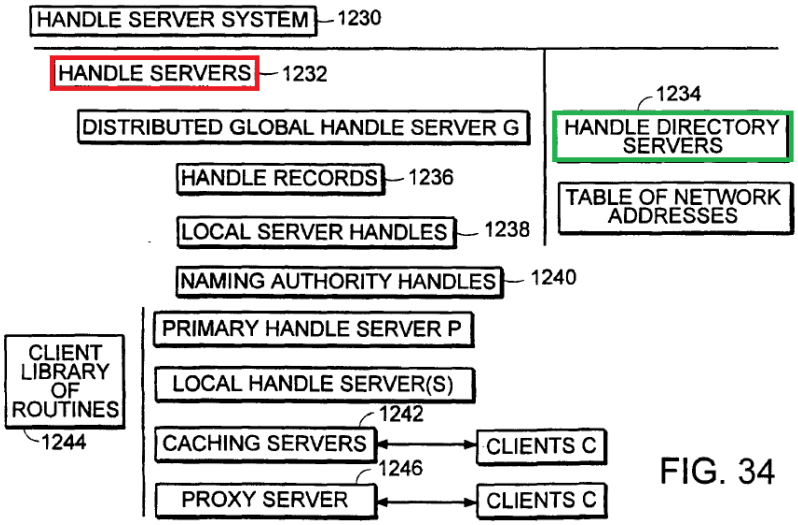


FIG. 34

87. Ex. 1005, Fig. 34. The handle directory servers contain "hash range/handle-server-domain-name tables" that a client can download if its first query is to the wrong handle server and it receives a "not-responsible-for-handle" message. *Id*, 47:9-21. The handle servers never receive or store the "hash range/handle-server-domain-name tables". Instead, those tables reside in the separate handle directory server and are downloadable by the client (not the handle server). *Id.*, 29:23-26. For example, Kahn states:

88. For example, the Kahn states:

> The system subsequently sends the handle to the handle server as part of a request pointer information UDP packet (step 178).
>
> The handle server then returns its response to the requesting system. If the handle server found the pointers, a list of pointers is returned (step 180). This could include pointers to use one or more repositories and

> one or more RMS's. **If the handle was sent to the wrong handle server, it returns a not-responsible-for-handle message (step 182).** In this case, **the client system should download the hash range/handle server-domain-name table from the handle server directory** again and attempt the mapping again. The requester will determine how many times to try before giving up (and this same approach is used in other similar situations described below).

Id., 47:5-21 (emphases added).

89. As such, when a client sends a query to a handle server and the handle server does not have the requested information, it sends back a "not-responsible-for-handle" message. *Id.*, 47:13-15. If the client receives the "not-responsible-for-handle" message, the client (not the handle server) may download a hash range/handle-server-domain-name tables from the handle directory server (not the handle server) and use that to determine the next server to query. *Id.*, 47:15-18. A POSITA would understand that Kahn never discloses a handle server returning a message to the client querying it that "contains a list of at least one other location server known to have the location information for the desired entity."

90. Vingralek teaches a "distributed file organization for record-structured, disk-resident files with key-based exact-match access." Ex. 1007 at 3. In the Vingralek system, a client *c* sends a key *K* to a server *s*. *Id*. at 9. Server *s* applies

certain hash functions to *K* until it identifies a server *s'* that it thinks has the records associated with *K*. *Id.* Vingralek says:

> If *K* does belong to the server that received it (i.e., if *s = s'),* the server performs the requested operation. However, if *K* has been sent to the wrong server, the server forwards it to *s',* and updates the client's view with its file level *L,* and its address table. Eventually, *K* is received by the correct server and the client operation is executed. Further, as an important side effect, clients gradually bring their perception of the file up-to-date, so that the probability of wrongly addressed messages is significantly reduced.

91. *Id*. at 10. In other words, if the queried server *s* does not have the requested information, server *s* performs the calculation to identify server *s'* and forwards the key on. Vingralek further indicates that "[t]he *address table* contains the mapping of bucket number onto server numbers." *Id.* at 8 (emphasis in original). As a result, if the queried server *s* does not have the requested information, server *s* performs the calculation to identify server *s*' and forwards the key on while also "update[ing] the client's view with its file level *L*, and its address table." In other words, server *s* returns to the client an updated look up table of *bucket to server* mappings. Ex1007 at 8.

92. A POSITA would understand that Vingralek's system does not satisfy the claim requirements. Vingralek's table of bucket-to-server mappings that it

returns to the client is a lookup table. *Id*. 9-10. The table does not identify which server among the in the network contains the sought-after information. In order to meet the limitation in question, Vingralek would have needed to return a message to the client identifying the server (from among the network of server) "*known to have*" the information associated with *K*. Vingralek's table of bucket-to-server mappings, however, does not identify which server among the universe of servers contains the desired information.

93. Petitioner and Dr. Chatterjee further allege that "[a] POSITA would have understood that Vingralek's redirect message including an address table may be implemented such that only the portion of the address table corresponding to the location server(s) that contain the requested location information ('a list of at least one other location server known to have the location information for the desired entity') would be sent in the message. This would allow the client to update the relevant portions of its own hash/address table, as well as provide the client with the addresses of the location server(s) that should receive the forwarded request." Pet., 49. Ex. 1002, ¶100. A POSITA would understand that neither Kahn nor Vingralek's teachings support this theory. Particularly, as indicated above, Kahn does not teach a handle server that can send message with any indication which handle server stores the sought-after information back to the client. Furthermore, Vingralek returns an

address table that provides bucket-to-server mappings for all servers, which do not identify which among them is known to have the sought-after information.

94. Petitioner's theory is not supported by sufficient analysis or evidence. Particularly, Petitioner's theory would not only require modifying Kahn with Vingralek's teachings, but additionally, modifying the Kahn-Vingralek combination. As indicated above, both Kahn nor Vingralek do not teach sending "a portion" of an address table to a client, as alleged by Petitioner and Dr. Chatterjee. *See supra* §X.A. Furthermore, both Kahn and Vingralek are silent about a client updating their local address table using a partial address table received from a server. A POSITA would understand that Kahn's client downloads a hash table and replaces the hash table stored locally at the access server with the newly downloaded version. Ex. 1005, 46:29-35. Vingralek teaches that a client's receives an updated address table the client. Ex. 1007, 9-10. In both references, the hash table that is received or downloaded is not a message that identifies which server is "known to have the location information for the desired entity." Neither Petitioner nor Dr. Chatterjee provide any evidentiary support or analysis for how or why a POSITA would find it obvious to modify the combination this way.

I hereby declare, under penalty of perjury under the laws of the United States, that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both.

Executed on November 20, 2024, in Irvine, CA.

Michael T. Goodrich

APPENDIX A

CURRICULUM VITAE
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EDUCATION

Ph.D.	1987	*Efficient Parallel Techniques for Computational Geometry* Computer Science, Purdue Univ. (M.J. Atallah, advisor)
M.S.	1985	Computer Science, Purdue Univ.
B.A.	1983	Mathematics and Computer Science, Calvin Univ.

PROFESSIONAL EXPERIENCE

July '19 to present	Distinguished Professor, Dept. of Computer Science Univ. of California, Irvine
March '10 to present	Technical Director, Center for Algorithms and Theory of Computation Univ. of California, Irvine
April '07 to June '19	Chancellor's Professor, Dept. of Computer Science Univ. of California, Irvine
July '12 to June '13	Chair, Dept. of Computer Science Univ. of California, Irvine
October '06 to June '12	Assoc. Dean for Faculty Dev., Bren School of Info. and Comp. Sci. Univ. of California, Irvine
July '01 to March '07	Professor, Dept. of Computer Science Univ. of California, Irvine
Fall '00	Visiting Professor of Computer Science Brown Univ.
July '96 to June '02	Professor of Computer Science (on leave, from July '01) Johns Hopkins Univ.
July '92 to June '96	Associate Professor of Computer Science Johns Hopkins Univ.
Spring '94	Visiting Associate Professor of Computer Science Univ. of Illinois, Urbana-Champaign
July '87 to June '92	Assistant Professor of Computer Science Johns Hopkins Univ.
Aug. '83 to June '87	Teaching Assistant, Research Assistant Purdue Univ.
Summer '83	Summer intern Argonne National Laboratory

RESEARCH INTERESTS

Algorithm and data structure design
Networking and parallel and distributed computing
Computer security and information assurance and privacy
Machine learning and computer vision
Databases and high-performance data management
Information visualization and graph drawing
Computational geometry and computer graphics

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PRIZES, HONORS, AND AWARDS

- *Compere Loveless Fellowship in Computer Sciences*, Purdue Univ., 1985
- *Research Initiation Award*, National Science Foundation, 1988
- *Oraculum Award for Excellence in Teaching*, Johns Hopkins, 1993, 1994, 1995
- *ACM Recognition of Service Award*, 1996
- *Robert B. Pond, Sr. Award for Excellence in Undergraduate Teaching*, Johns Hopkins, 1998
- *Elected Senior Member*, the Institute of Electrical and Electronics Engineers (IEEE), 1999
- *Spirit of Technology Transition Award*, DARPA Dynamic Coalitions Program, 2002
- *Brown Univ. Award for Technological Innovation* (with R. Tamassia, N. Triandopoulos, D. Yao, and D. Ellis), 2006
- *ACM Distinguished Scientist*, 2006
- *2006 IEEE Computer Society Technical Achievement Award*, "for outstanding contributions to the design of parallel and distributed algorithms for fundamental combinatorial and geometric problems"
- *Fulbright Scholar*, 2007, for senior specialist service to University of Aarhus, Denmark
- *Fellow of the San Diego Supercomputer Center*, 2007
- *Fellow of the American Association for the Advancement of Science (AAAS)*, "for distinguished contributions to parallel and distributed algorithms for combinatorial and geometric problems, and excellence in teaching, academic and professional service, and textbook writing," 2007
- *Named as Chancellor's Professor*, for "demonstrated unusual academic merit and whose continued promise for scholarly achievement is unusually high," Univ. of California, Irvine, 2007
- *Fellow of the Institute of Electrical and Electronics Engineers (IEEE)*, "for contributions to parallel and distributed algorithms for combinatorial and geometric problems," 2009
- *Fellow of the ACM*, "for contributions to data structures and algorithms for combinatorial and geometric problems," 2009
- *ICS Dean's Award for Research*, "for contributions in the area of parallel and distributed algorithms," 2014
- *Chancellor's Award for Excellence in Fostering Undergraduate Research*, Univ. of California, Irvine, 2016
- *Faculty Mentor of the Month*, Undergraduate Research Opportunities Program (UROP), Univ. of California, Irvine, April 2016
- *Elected as a foreign member*, Royal Danish Academy of Sciences and Letters, April 2018
- *Named as Distinguished Professor*, for achieving "the highest levels of scholarship" over the course of a career and having "earned national and international level distinctions and honors of the highest level," Univ. of California, Irvine, 2019
- *Recipient of The Alejandro López-Ortiz Best Paper Award*, for "Zip-zip Trees: Making Zip Trees More Balanced, Biased, Compact, or Persistent," 18th Algorithms and Data Structures Symposium, 2023.

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Google Scholar Citation Statistics:

- Total citations: over 18,000
- H-index (top H publications with at least H citations): 73

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P-3. M.T. Goodrich and R. Tamassia, "Efficient Authenticated Dictionaries with Skip Lists and Commutative Hashing," U.S. Patent No. 7,257,711, August 14, 2007.

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P-5. R. Tamassia, M.T. Goodrich, and N. Triandopoulos, "Super-efficient Verification of Dynamic Outsourced Databases," International Patent Application Pub. No. WO 2008/014002, January 31, 2008.

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P-9. R. Tamstorf, M.T. Goodrich, D. Eppstein, "Attribute Transfer Between Computer Models Including Identifying Isomorphic Regions in Polygonal Meshes," U.S. Patent No. 8,681,145, March 25, 2014.

P-10. N. Triandopoulos, M.T. Goodrich, D. Nguyen, O. Ohrimenko, C. Papamanthou, R. Tamassia, C.V. Lopes, "Techniques for Verifying Search Results Over a Distributed Collection," U.S. Patent No. 9,152,716, October 6, 2015.

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N-8. C. Kuesel, "Scientists may have solved the mystery behind the glass orb in 'Salvator Mundi,'" *Artsy*, https://www.artsy.net/article/artsy-editorial-scientists-solved-mystery-glass-orb-salvator-mundi, January 3, 2020.

N-9. S. Pappas, "Mystery of Orb in a Record-Breaking Leonardo Da Vinci Painting Deepens," *LiveScience*, https://www.livescience.com/da-vinci-light-orb-mystery.html, January 13, 2020.

N-10. S. Murray, "Computer Scientists Make a Splash in Art World Analyzing the *Salvator Mundi*," UCI ICS In The News, https://www.ics.uci.edu/community/news/view_news?id=1706, February 11, 2020.

N-11. A. Gorale, "Bitcoin in Bloom: How IBLTs Allow Bitcoin to Scale," *CCN*, https://www.ccn.com/bitcoin-in-bloom-how-iblts-allow-bitcoin-scale/, March 4, 2021.

N-12. R. Miller, "Mike Goodrich's New zyVersion: Bringing Interactivity to Algorithm Design and Application Textbook," *zyBooks*, https://www.zybooks.com/mike-goodrichs-new-zyversion-bringing-interactivity-to-algorithm-design-and-application-textbook/, October 3, 2022.

N-13. S. Murray, "ICS Researchers Receive Best Paper Award at Algorithms and Data Structures Symposium," UCI ICS In The News, https://www.ics.uci.edu/community/news/view_news?id=2351, July 18, 2023.

PROFESSIONAL SERVICE

Guest Editor:

Int. Journal of Computational Geometry & Applications, **2**(2), 1992
Journal of Computer & System Sciences, **52**(1), 1996
Computational Geometry: Theory and Applications, **12(1–2)**, 1999.
Algorithmica, **33**(3), 2002.

Editorial Board Membership:

Computational Geometry: Theory and Applications, 2006–2015
Journal of Computer & System Sciences, 1994–2011
Journal of Graph Algorithms and Applications, 1996–2011
Int. Journal of Computational Geometry & Applications, 1993–2010
Information Processing Letters, 1995–1997

Journal Advisory Board Membership:

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Int. Journal of Computational Geometry & Applications, 2010–
Journal of Graph Algorithms and Applications, 2011–

Program Committee Service:

7th ACM Symp. on Computational Geometry (SoCG), 1991
1991 Workshop on Algorithms and Data Structures (WADS)
8th ACM Symp. on Computational Geometry (SoCG), 1992
25th ACM Symp. on Theory of Computing (STOC), 1993
Chair, 26th ACM Symp. on Theory of Computing (STOC), 1994
11th ACM Symp. on Computational Geometry (SoCG), 1995
DAGS '95 Conf. on Electronic Publishing and the Information Superhighway
1996 SIAM Discrete Mathematics Conference
1997 Workshop on Algorithms and Data Structures (WADS)
Int. Symp. on Graph Drawing (GD), 1997
1999 Workshop on Algorithms and Data Structures (WADS)
Co-chair, Workshop on Algorithm Engineering and Experimentation (ALENEX), 1999
Int. Symp. on Graph Drawing (GD), 2000
2000 Workshop on Algorithm Engineering (WAE)
41st IEEE Symp. on Foundations of Computer Science (FOCS), 2000
2001 Workshop on Algorithms and Data Structures (WADS)
Int. Symp. on Graph Drawing (GD), 2001
Workshop on Algorithm Engineering and Experimentation (ALENEX), 2002
18th ACM Symp. on Computational Geometry (SoCG), 2002
13th ACM-SIAM Symp. on Discrete Algorithms (SODA), 2002
Co-Chair, Graph Drawing 2002
Int. Symp. on Graph Drawing (GD), 2003
16th ACM-SIAM Symp. on Discrete Algorithms (SODA), 2005
32nd Int. Colloq. on Automata, Languages and Programming (ICALP), 2005
12th Int. Computing and Combinatorics Conference (COCOON), 2006
13th ACM Conf. on Computer and Communication Security (CCS), 2006
15th European Symp. on Algorithms (ESA), 2007
5th Int. Conference on Applied Cryptography and Network Security (ACNS), 2007
21st IEEE Int. Parallel & Distributed Processing Symp. (IPDPS), 2007
19th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA), 2007
5th Workshop on Algorithms and Models for the Web-Graph (WAW), 2007
7th Int. Workshop on Experimental Algorithms (WEA), 2008
Second Int. Frontiers of Algorithmics Workshop (FAW), 2008
16th ACM SIGSPATIAL Int. Symp. on Adv. in Geographic Information Systems (GIS), 2008
17th ACM SIGSPATIAL Int. Symp. on Adv. in Geographic Information Systems (GIS), 2009
31st IEEE Symp. on Security and Privacy (S&P), 2010
18th Int. Symp. on Graph Drawing (GD), 2010
2011 Workshop on Analytic Algorithmics and Combinatorics (ANALCO)
8th Workshop on Algorithms and Models for the Web Graph (WAW), 2011
19th Int. Symp. on Graph Drawing (GD), 2011
24th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA), 2012
20th European Symp. on Algorithms (ESA), 2012
2013 IEEE Int. Conf. on Big Data (BigData), 2013
30th IEEE Int. Conf. on Data Engineering (ICDE), 2014
21st ACM Conf. on Computer and Communication Security (CCS), 2014
Symp. on Algorithms and Data Structures (WADS), 2015
ACM Cloud Computing Security Workshop (CCSW), 2015
Int. Symp. on Graph Drawing (GD), 2015

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co-chair, 2016 Workshop on Algorithm Engineering and Experiments (ALENEX)
2016 Workshop on Massive Data Algorithmics (MASSIVE)
2016 Int. Symp. on Algorithms and Computation (ISAAC)
29th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA), 2017
25th ACM SIGSPATIAL Int. Conf. on Adv. in Geographic Information Systems (GIS), 2017
26th European Symp. on Algorithms (ESA), 2018
26th ACM SIGSPATIAL Int. Conf. on Adv. in Geographic Information Systems (GIS), 2018
2nd SIAM Symp. on Simplicity in Algorithms (SOSA), 2019
ACM SIGSPATIAL Int. Workshop on Spatial Gems, 2019
2021 SIAM Symp. on Applied Computational & Discrete Algorithms (ACDA)
2023 SIAM Symp. on Algorithm Engineering and Experimentation (ALENEX)
35th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA), 2023
7th SIAM Symp. on Simplicity in Algorithms (SOSA), 2024

Conference/Workshop Committee Service:

Conference chair, 12th ACM Symp. on Computational Geometry, 1996
Organizer, 1st CGC Workshop on Computational Geometry, 1996
Co-chair, 1999 Dagstuhl Workshop on Computational Geometry, 1999
Conference chair, Graph Drawing, 2002
Co-organizer, Hawaiian Workshop on Parallel Algorithms, 2017, 2019
Member, Symp. on Theory of Computing (STOC) Test of Time Award Committee, 2024

Steering Committee and Executive Committee Service:

Member at large, ACM SIG on Algorithms & Comp. Theory (SIGACT) Exec. Comm., 1993–97
Member, Exec. comm. for 1996 Federated Computing Research Conference (FCRC)
co-Founder and member, Steering Comm. for Workshop on Algorithm Engineering and Experimentation (ALENEX), 1999–2017 (chair, 2014–16)
co-Chair, Steering Comm. for ACM Symp. on Computational Geometry, 1999–2001
Member, Steering Comm. for Graph Drawing Conference, 2000–03, 2014–16
Conference Chair, ACM SIG on Algorithms & Comp. Theory (SIGACT), 2005–09

Center and Institute Affiliations:

Algorithms, Combinatorics and Optimization Center, UCI
Center for Algorithms and Theory of Computation, UCI
Center for Embedded and Cyber-physical Systems, UCI
Center for Machine Learning and Intelligent Systems, UCI
The Institute for Virtual Environments and Computer Games (IVECG), UCI
Secure Computing & Networking Center, UCI

Postdoctoral Fellows:

1. Timothy Chan, Johns Hopkins, 1996. (Now at Univ. of Illinois)
2. Gill Barequet, Johns Hopkins, 1996-98. (Now at Technion)
3. Pawel Gajer, Johns Hopkins, 2000. (Now at Univ. of Maryland)
4. Amitabh Chaudhary, UC-Irvine, 2002-2004. (Now at U. Chicago)
5. Amitabha Bagchi, UC-Irvine, 2002-2004. (Now at IIT-Dehli)
6. Martin Nöllenburg, UC-Irvine, 2010, mentored jointly with David Eppstein. (Now at TU Wien)
7. Maarten Löffler, UC-Irvine, 2010-2011, mentored jointly with David Eppstein. (Now at Utrecht University)
8. Md. Jawaherul Alam, UC-Irvine, 2015-16. (Now at Amazon)
9. Giordano Da Lozzo, UC-Irvine, 2016-2017, mentored jointly with David Eppstein. (Now at "Roma Tre" University)

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Ph.D. Students:

1. Mujtaba Ghouse, "Randomized Parallel Computational Geometry in Theory and Practice," Johns Hopkins Univ., May 1993.
2. Paul Tanenbaum, "On Geometric Representations of Partially Ordered Sets," Johns Hopkins Univ., May 1995 (co-advised with Edward Scheinerman).
3. Mark Orletsky, "Practical Methods for Geometric Searching Problems with Experimental Validation," Johns Hopkins Univ., May 1996.
4. Kumar Ramaiyer, "Geometric Data Structures and Applications," Johns Hopkins Univ., Aug. 1996.
5. Christian Duncan, "Balanced Aspect Ratio Trees," Johns Hopkins Univ., Aug. 1999.
6. Christopher Wagner, "Graph Visualization and Network Routing," Johns Hopkins Univ., Oct. 1999 (co-advised with Prof. Lenore Cowen).
7. Stephen Kobourov, "Algorithms for Drawing Large Graphs," Johns Hopkins Univ., May 2000.
8. Amitabha Bagchi, "Efficient Strategies for Topics in Internet Algorithmics," Johns Hopkins Univ., Oct. 2002.
9. Amitabh Chaudhary, "Applied Spatial Data Structures for Large Data Sets," Johns Hopkins Univ., Oct. 2002.
10. Breno De Medeiros, "New Cryptographic Primitives with Applications to Information Privacy and Corporate Confidentiality," Johns Hopkins Univ., May 2004 (co-advised with Giuseppe Ateniese).
11. "Jeremy" Yu Meng, "Confluent Graph Drawing," UC-Irvine, June 2006.
12. Jonathan Zheng Sun, "Algorithms for Hierarchical Structures, with Applications to Security and Geometry," UC-Irvine, Aug. 2006.
13. Nodari Sitchinava, "Parallel External Memory Model—A Parallel Model for Multi-core Architectures," UC-Irvine, Sep. 2009.
14. Darren Strash, "Algorithms for Sparse Geometric Graphs and Social Networks," UC-Irvine, May 2011 (co-advised with with David Eppstein).
15. Lowell Trott, "Geometric Algorithms for Social Network Analysis," UC-Irvine, May 2013.
16. Joseph Simons, "New Dynamics in Geometric Data Structures," UC-Irvine, May 2014.
17. Pawel Pszona, "Practical Algorithms for Sparse Graphs," UC-Irvine, May 2014.
18. William E. Devanny, "An Assortment of Sorts: Three Modern Variations on the Classic Sorting Problem," UC-Irvine, July 2017 (co-advised with David Eppstein).
19. Siddharth Gupta, "Topological Algorithms for Geographic and Geometric Graphs," UC-Irvine, Aug. 2018 (co-advised with with David Eppstein).
20. Timothy Johnson, "Graph Drawing Representations and Metrics with Applications," UC-Irvine, Aug. 2018.
21. Juan Besa, "Optimization Problems in Directed Graph Visualization," UC-Irvine, Aug. 2019.
22. Nil Mamano Grande, "New Applications of the Nearest-Neighbor Chain Algorithm," UC-Irvine, Sep. 2019 (co-advised with David Eppstein).
23. Pedro Matias, "Exact Learning of Sequences from Queries and Trackers," UC-Irvine, May 2021
24. Martha Osegueda, "Constructing, Counting and Matching Combinatorial and Geometric Shapes," UC-Irvine, May 2022
25. Ramtin Afshar, "Exact Learning of Graphs Using Queries," UC-Irvine, Feb. 2023
26. Evrim Ozel, "Efficient Algorithms for Road Networks and Noisy Sorting: an Experimental and Theoretical Perspective," UC-Irvine, May 2024

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Ph.D. Committee Service:

John Augustine	UC-Irvine	Advancement to candidacy, September 2003
Nikos Triandopoulos	Brown U.	Thesis prelim., February 2004
Einar Mykletun	UC-Irvine	Advancement to candidacy, March 2004
Kartic Subr	UC-Irvine	Advancement to candidacy, September 2004
S. Joshua Swamidass	UC-Irvine	Advancement to candidacy, April 2005
Jeong Hyun Yi	UC-Irvine	Thesis defense, August, 2005
Nodari Sitchinava	UC-Irvine	Advancement to candidacy, chair, December 2005
John Augustine	UC-Irvine	Thesis defense, July 2006
Maithili Narasimha	UC-Irvine	Thesis defense, August, 2006
Josiah Carlson	UC-Irvine	Advancement to candidacy, August 2006
Xiaomin Liu	UC-Irvine	Advancement to candidacy, September 2006
Gabor Madl	UC-Irvine	Advancement to candidacy, September 2006
Nikos Triandopoulos	Brown U.	Thesis defense, September 2006
Rabia Nuray-Turan	UC-Irvine	Advancement to candidacy, May 2007
S. Joshua Swamidass	UC-Irvine	Thesis defense, June 2007
Michael Sirivianos	UC-Irvine	Advancement to candidacy, June 2007
Kevin Wortman	UC-Irvine	Advancement to candidacy, August 2007
Di Ma	UC-Irvine	Advancement to candidacy, December 2007
Josiah Carlson	UC-Irvine	Thesis defense, December 2007
Michael Nelson	UC-Irvine	Advancement to candidacy, chair, March 2008
Minas Gjoka	UC-Irvine	Advancement to candidacy, June 2008
Sara Javanmardi	UC-Irvine	Advancement to candidacy, June 2008
Ali Zandi	UC-Irvine	Advancement to candidacy, September 2008
Jihye Kim	UC-Irvine	Thesis defense, September 2008
Darren Strash	UC-Irvine	Advancement to candidacy, December 2008
Kevin Wortman	UC-Irvine	Topic defense, January 2009
Nodari Sitchinava	UC-Irvine	Topic defense, chair, June 2009
Fabio Soldo	UC-Irvine	Advancement to candidacy, July 2009
Emil De Cristofaro	UC-Irvine	Advancement to candidacy, July 2009
Di Ma	UC-Irvine	Thesis defense, August 2009
Yanbin Lu	UC-Irvine	Advancement to candidacy, December 2009
Anh Le	UC-Irvine	Advancement to candidacy, April 2010
Lowell Trott	UC-Irvine	Advancement to candidacy, June 2010
Xiaomin Liu	UC-Irvine	Thesis defense, August 2010
Josh Olsen	UC-Irvine	Advancement to candidacy, September 2010
Yasser Altowim	UC-Irvine	Advancement to candidacy, December 2010
Angela Wong	UC-Irvine	Advancement to candidacy, May 2011
Joshua Hill	UC-Irvine	Advancement to candidacy, September 2011
Alex Abatzoglou	UC-Irvine	Advancement to candidacy, September 2011
Michael Wolfe	UC-Irvine	Masters Thesis defense, October 2011
Olya Ohrimenko	Brown Univ.	PhD Thesis proposal, October 2011
Yanbin Lu	UC-Irvine	PhD Thesis defense, November 2011
Chun Meng	UC-Irvine	Advancement to candidacy, December 2011
Abinesh Ramakrishnan	UC-Irvine	Advancement to candidacy, March 2012
Pegah Sattari	UC-Irvine	PhD Thesis defense, April 2012
Michael Bannister	UC-Irvine	PhD Thesis defense, May 2015

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Yingyi Bu	UC-Irvine	PhD Thesis defense, August 2015
Jenny Lam	UC-Irvine	PhD Thesis defense, November 2015
Timothy Johnson	UC-Irvine	Advancement to candidacy, chair, June 2016
Jiayu Xu	UC-Irvine	Advancement to candidacy, November 2016
Sky Faber	UC-Irvine	PhD Thesis defense, November 2016
Juan Jose Besa Vial	UC-Irvine	Advancement to candidacy, chair, March 2017
William Devanny	UC-Irvine	PhD Thesis defense, co-chair, July 2017
Ingo van Duijn	Aarhus Univ.	PhD Thesis defense, September 2017
Siddharth Gupta	UC-Irvine	Advancement to candidacy, January 2018
Boyang Wei	UC-Irvine	PhD Thesis defense, August 2018
Timothy Johnson	UC-Irvine	PhD Thesis defense, chair, August 2018
Siddharth Gupta	UC-Irvine	PhD Thesis defense, August 2018
Pedro Matias	UC-Irvine	Advancement to candidacy, chair, May 2019
Juan Jose Besa Vial	UC-Irvine	PhD Thesis defense, chair, August 2019
Sameera Chayyur	UC-Irvine	Advancement to candidacy, September 2019
Nil Mamano Grande	UC-Irvine	PhD Thesis defense, co-chair, September 2019
Yihan Sun	CMU	PhD Thesis defense, October 2019
Martha Osegueda	UC-Irvine	Advancement to candidacy, chair, June 2020
Tatiana Bradley	UC-Irvine	PhD Thesis defense, December 2020
Julius Ceasar Aguma	UC-Irvine	Advancement to candidacy, December 2020
Ramtin Afshar	UC-Irvine	Advancement to candidacy, chair, March 2021
Pedro Matias	UC-Irvine	PhD Thesis defense, chair, May 2021
Elham Havvaei	UC-Irvine	PhD Thesis defense, May 2021
Daniel Frishberg	UC-Irvine	Advancement to candidacy, May 2021
Hadi Khodabandeh	UC-Irvine	Advancement to candidacy, July 2021
Sameera Ghayyur	UC-Irvine	PhD topic defense, February 2022
Evrim Ozel	UC-Irvine	Advancement to candidacy, chair, May 2022
Rohith Gangam	UC-Irvine	Advancement to candidacy, May 2022
Martha Osegueda	UC-Irvine	PhD Thesis defense, chair, May 2022
Yanqi Gu	UC-Irvine	Advancement to candidacy, June 2022
Sameera Ghayyur	UC-Irvine	PhD Thesis defense, August 2022
Rasmus K. Petersen	Aarhus Univ.	PhD Thesis defense, Sept. 2022
Zihan Yu	UC-Irvine	Advancement to candidacy, Nov. 2022
Ramtin Afshar	UC-Irvine	PhD Thesis defense, chair, Feb. 2023
Shanshan Han	UC-Irvine	Advancement to candidacy, Feb. 2023
Zhanhang (Marco) Liang	UC-Irvine	Advancement to candidacy, Mar. 2023
Shion Fukuzawa	UC-Irvine	Advancement to candidacy, co-chair, Mar. 2023
Ryuto Kitagawa	UC-Irvine	Advancement to candidacy, chair, May 2024
Ofek Gila	UC-Irvine	Advancement to candidacy, chair, May 2024
Po-Chu Hsu	UC-Irvine	Advancement to candidacy, May 2024
Yanqi Gu	UC-Irvine	PhD Thesis defense, May 2024
Evrim Ozel	UC-Irvine	PhD Thesis defense, chair, May 2024
Hadi Khodabandeh	UC-Irvine	PhD Thesis defense, June 2024

University Service:

Ph.D. Requirements Committee, Dept. of Computer Science, chair: 1987–89
Graduate Admissions Committee, Dept. of Computer Science, 1991–1993 (chair: 1992)
Faculty Recruiting Committee, Dept. of Computer Science, 1993,95,96 (chair: 1996)

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Steering Committee, Whiting School of Engineering, 1990–93 (chair, 1993)
Johns Hopkins Homewood Academic Computing Oversight Committee, 1990–93
Curriculum Committee, Whiting School of Engineering, 1994–96
Strategic Planning Committee, Whiting School of Engineering, 1999–00
Graduate Policy Committee, UCI Dept. of Information & Computer Science (ICS), 2001–02
Faculty Search Committee in Cryptography, UCI Dept. of ICS, 2001–03
School of Info. and Computer Science Executive Committee, 2002–04
UCI Committee on Educational Policy (CEP), 2002–03, 2004–06
UCI Change of Major Criteria Committee, 2002–03
UCI CEP Policy Subcommittee, 2002–2003
Distinguished Faculty Search Committee, Bren School of ICS, 2004–11 (chair, 2007–08)
Equity Advisor, Bren School of ICS, 2005–09
Dean's Advisory Council, Bren School of ICS, 2007–13
Associate Dean for Faculty Development, Bren School of ICS, 2006–12
Chair, Department of Computer Science, Bren School of ICS, 2012–13
Master of Computer Science Development Committee, Bren School of ICS, 2013–16
Stragic Planning Committee, Dept. of Computer Science, Bren School of ICS, 2015–16
Executive Committee, Bren School of ICS, 2017–18
UC-Irvine Senate Committee on Scholarly Honors & Awards, 2017–20
UC-Irvine Special Research Program Review Committee for CalIT2, 2018–19
UC-Irvine Year of Scholarly Values Advisory Committee, 2024–
Master of Computer Science Steering/Admissions Comm., Bren School of ICS, 2016–22, 2024–

Courses Taught and Developed:

Advanced Parallel Computing (developed and taught at Johns Hopkins)
Cyber-Puzzlers (designed and taught at UCI)
Computer Literacy (taught at Purdue, developed at Johns Hopkins)
Computer Programming for Scientists and Engineers (taught at Purdue)
Computer Security Algorithms (developed and taught at UCI)
Computational Models (revised and taught at Johns Hopkins)
Computational Geometry (revised and taught at Johns Hopkins and UCI)
Compiler Theory and Design (revised and taught at Johns Hopkins)
Computer Graphics (taught at Johns Hopkins)
Cyber-Fraud Detection and Prevention (designed and taught at UCI)
Data Structures (revised and taught at Johns Hopkins and UCI)
Graph Algorithms (revised and taught at UCI)
Formal Languages and Automata Theory (revised and taught at UCI)
Fundamentals of Algorithms with Applications (revised and taught at UCI)
Introduction to Algorithms (developed and taught at Johns Hopkins and UCI)
Internet Algorithmics (developed and taught at Johns Hopkins, Brown, and UCI)
Design and Analysis of Algorithms (revised and taught at Johns Hopkins and UCI)
Parallel Algorithms (developed and taught at Johns Hopkins and Univ. of Illinois)
Project in Algorithms and Data Structures (revised and taught at UCI)
Text Processing and Pattern Matching (developed and taught at UCI)

Consulting:

The National Science Foundation, proposal panel member, 1990–
Army Research Laboratory, Fort Belvior, 1995
Battelle Research Triangle, Columbus Division, 1996

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AT&T, 1998
Univ. of Miami, 1999
Algomagic Technologies, Inc., 2000–2005
Brown University, 2000–2007
Purdue University, 2002
APAC Security, Inc., 2005
Walt Disney Animation Studios, 2009
Technical expert and expert witness, 2012–
3M, 2015

GRANTS AND CONTRACTS

1. PI, "Research Initiation Award: Parallel and Sequential Computational Geometry," National Science Foundation (NSF Grant CCR-8810568), $32,914, 1988–90.
2. co-PI, "Paradigms for Parallel Algorithm Design," NSF and DARPA (as NSF Grant CCR-8908092), $523,837, 1989–93 (with S.R. Kosaraju (PI), S. Kasif, and G. Sullivan).
3. PI, "Parallel Computation and Computational Geometry," NSF (Grant CCR-9003299), $67,436, 1990–93.
4. co-PI, "A Facility for Experimental Validation," NSF (Grant CDA-9015667), $1,476,147, 1991–96 (with G. Masson (PI), J. Johnstone, S. Kasif, S.R. Kosaraju, S. Salzberg, S. Smith, G. Sullivan, L. Wolff, and A. Zwarico).
5. PI, "Parallel Network Algorithms for Cell Suppression," The Bureau of the Census (JSA 91-23), $14,998 1991–92.
6. PI, "A Geometric Framework for the Exploration & Analysis of Astrophysical Data," NSF (Grant IRI-9116843), $535,553, 1991–96 (with S. Salzberg and H. Ford (from Physics and Astronomy Dept.)).
7. PI, "Research Experiences for Undergraduates supplement to IRI-9116843," NSF, $4,000, 1993–94 (with S. Salzberg and H. Ford).
8. PI, "Constructing, Maintaining, and Searching Geometric Structures," NSF (Grant CCR-9300079), $134,976, 1993–96.
9. co-PI, "Robust and Applicable Geometric Computing," Army Research Office (ARO MURI Grant DAAH04-96-1-0013), $4,500,000, 1996–2000 (with F. Preparata (PI, Brown U.), R. Tamassia (Brown U.), S. Rao Kosaraju, J. Vitter (Duke U.), and P. Agarwal (Duke U.)). Subaward size: $1,466,640.
10. PI, "Application-Motivated Geometric Algorithm Design," NSF (Grant CCR-9625289), $107,389, 1996-98.
11. co-PI, "vBNS Connectivity for the Johns Hopkins University," NSF, $350,000, 1997–99 (with T.O. Poehler (PI), D.J. Binko, J.G. Neal, and A.S. Szalay).
12. co-PI, "Product Donation, Technology for Education Program," Intel Corporation, $480,071, 1997–2001 (with T.O. Poehler (PI), J.H. Anderson, A.S. Szalay, and M. Robbins).
13. co-PI, "A Networked Computing Environment for the Manipulation & Visualization of Geometric Data" (Research Infrastructure), NSF, $1,638,785, 1997–2003 (with L.B. Wolff (PI), Y. Amir, S.R. Kosaraju, S. Kumar, R. Tamassia (Brown U.), R.H. Taylor, and D. Yarowsky).
14. PI, "Geometric Algorithm Design and Implementation," NSF, Grant CCR-9732300, $224,982, 1998–2002.
15. PI, "Certification Management Infrastructure – Certificate Revocation," $52,023, 1998, NSA LUCITE grant.
16. PI, "Software Engineering Data Loading, Analysis, and Reporting," $41,614, 1998, NSA

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LUCITE grant.

17. PI, "Establishing a LUCITE Collaboration Environment," $10,018, 1998, NSA LUCITE grant.
18. PI, "In Support of a Secure Multilingual Collabortive Computing Environment," $51,471, 1999-2000, NSA LUCITE grant.
19. PI, "Accessing Large Distributed Archives in Astronomy and Particle Physics," $199,981. subcontract to UCI from Johns Hopkins Univ. on NSF Grant PHY-9980044 (total budget, $2,500,000), 1999–2004.
20. PI, "Efficient and Scalable Infrastructure Support for Dynamic Coalitions," $1,495,000, DARPA Grant F30602-00-2-0509, 2000-2003 (with Robert Cohen and Roberto Tamassia), including $227,893 subaward to UCI (with Gene Tsudik).
21. PI, "Graph Visualization and Geometric Algorithm Design," $400,000, NSF Grant CCR-0098068, 2001-2004 (with Roberto Tamssia).
22. PI, "Collaborative Research: Teaching Data Structures to the Millennium Generation," $125,00, NSF Grant DUE-0231467, 2003–2005.
23. PI, "Collaborative Research: An Algorithmic Approach to Cyber-Security," $100,000, NSF Grant CCR-0311720, 2003–2006.
24. PI, "The OptIPuter," $900,000, subcontract from UCSD on NSF ITR grant CCR-0225642 (total budget, $13.5 million), 2002–2007 (with Padhraic Smyth and Kane Kim).
25. PI, "ITR: Algorithms for the Technology of Trust," $300,000, NSF Grant CCR-0312760, 2003–2009.
26. co-PI, "SDCI Data New: Trust Management for Open Collaborative Information Repositories: The CalSWIM Cyberinfrastructure," NSF grant OCI-0724806, $1,103,590, 2007–2012.
27. co-PI, "Support for Machine Learning Techniques for Cyber-Fraud Detection," Experian Corporation, $200,000 gift, 2008.
28. PI, "IPS: Collaborative Research: Privacy Management, Measurement, and Visualization in Distributed Environments," NSF Grant IIS-0713046, $224,851, 2007–2009.
29. PI, "Collaborative Research: Algorithms for Graphs on Surfaces," $400,000, NSF Grant CCR-0830403, 2008–2011.
30. PI, "ROA Supplement: IPS: Collaborative Research: Privacy Management, Measurement, and Visualization in Distributed Environments," NSF Grant IIS-0847968, $25,000, 2008–2009.
31. co-investigator, "Scalable Methods for the Analysis of Network-Based Data," Office of Naval Research: Multidisciplinary University Research Initiative (MURI) Award, number N00014-08-1-1015, $529,152, 2008–2014.
32. PI, "EAGER: Usable Location Privacy for Mobile Devices," NSF Grant 0953071, $300,000, 2009–2011.
33. PI, "TC:Large:Collaborative Research: Towards Trustworthy Interactions in the Cloud," NSF Grant 1011840, $500,000, 2010-2015.
34. PI, "TWC: Medium: Collaborative: Privacy-Preserving Distributed Storage and Computation," NSF Grant 1228639, $390,738, 2012-2018.
35. PI, "Support for Research on Geometric Motion Planning," 3M Corporation, $40,000 gift, 2014.
36. PI, "A4V: Automated Analysis of Algorithm Attack Vulnerabilities," subcontract 10036982-UCI from University of Utah for DARPA agreement no. AFRL FA8750-15-2-0092, $980,000, 2015–2019.
37. PI, "TWC: Small: Collaborative: Practical Security Protocols via Advanced Data Structures," NSF Grant 1526631, $166,638, 2015–2018.

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38. PI, "NSF-BSF: AF: Small: Geometric Realizations and Evolving Data," NSF Grant 1815073, $474,392, 2018–2022.
39. PI, "Collaborative Research: AF: Medium: Algorithms for Geometric Graphs," NSF Grant 2212129, $799,800, 2022–2026.

SELECTED INVITED TALKS (RECENT YEARS ONLY)

- "Probabilistic Packet Marking for Large-Scale IP Traceback," Purdue Univ., 2003
- "Algorithms for Data Authentication," Harvey Mudd College, 2003
- "Efficient Tree-Based Revocation in Groups of Low-State Devices," Univ. of Arizona, 2004
- "Leap-Frog Packet Linking and Diverse Key Distributions for Improved Integrity in Network Broadcasts," Southern California Security and Cryptography Workshop, 2005
- "Is Your Business Privacy Protected?," NEXT Connections, 2005
- "Distributed Peer-to-peer Data Structures," Harvard Univ., 2006
- "Balancing Life with an Academic Research Career," Grace Hopper Conference, 2006
- "Computer Security in the Large," Univ. Texas, San Antonio, 2006
- "Inspirations in Parallelism and Computational Geometry," Brown Univ., 2006
- "Efficiency and Security Issues for Distributed Data Structures," Computer Science Distinguished Lecture Series, Johns Hopkins Univ., 2006
- "Efficiency and Security Issues for Distributed Data Structures," UCLA, 2006
- "Efficiency and Security Issues for Distributed Data Structures," Edison Distinguished Lecturer Series, Univ. of Notre Dame, 2006
- "Efficiency and Security Issues for Distributed Data Structures," Computer Science Distinguished Lecturer Series, Texas A & M Univ., 2006
- "Algorithms for Secure Computing and Searching with Applications to Medical Informatics," Purdue Univ., 2006
- "Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security," Univ. of Southern California, 2007
- "Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security," Univ. California, San Diego, 2007
- "Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security," Univ. Minnesota, 2007
- "Blood on the Database: How Algorithms for Testing Blood Samples can be Used for Database Integrity," Invited Keynote, 21st Annual IFIP WG 11.3 Working Conference on Data and Applications Security (DBSec), 2007
- "Space-Efficient Straggler Identification," ALCOM Seminar, Univ. of Aarhus, 2007
- "Blood on the Computer: How Algorithms for Testing Blood Samples can be used in Modern Applications," ALCOM Seminar, Univ. of Aarhus, 2007
- "Studying Road Networks Through an Algorithmic Lens," ALCOM Seminar, Univ. of Aarhus, 2008
- "Studying Geometric Graph Properties of Road Networks Through an Algorithmic Lens," Int. Workshop on Computing: from Theory to Practice, 2009
- "Randomized Shellsort: A Simple Oblivious Sorting Algorithm," Distinguished Lecture Series, Department of Computer Science, Brown University, 2009
- "Simulating Parallel Algorithms in the MapReduce Framework with Applications to Parallel Computational Geometry," MASSIVE 2010

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- "Data Cloning Attacks for Nearest-Neighbor Searching based on Retroactive Data Structures," Department of Computer Science, UCSB, 2011
- "Turning Privacy Leaks into Floods: Surreptitious Discovery of Social Network Friendships and Other Sensitve Binary Attribute Vectors," Department of Computer Science Distinguished Lecturer Series, Univ. of Illinois, Chicago, 2011
- "Turning Privacy Leaks into Floods: Surreptitious Discovery of Social Network Friendships and Other Sensitve Binary Attribute Vectors," Department of Computer Science, Purdue Univ., 2011
- "Spin-the-bottle Sort and Annealing Sort: Oblivious Sorting via Round-robin Random Comparisons," Department of Computer Science, Brown Univ., 2012
- "Using Data-Oblivious Algorithms for Private Cloud Storage Access," Qatar University, 2013
- "Using Data-Oblivious Algorithms for Private Cloud Storage Access," Department of Computer Science and Engineering Distinguished Speaker Series, University of Buffalo, 2013
- "Force-Directed Graph Drawing Using Social Gravity and Scaling," invited talk, ICERM Workshop on Stochastic Graph Models, Providence, RI, 2014
- "Invertible Bloom Lookup Tables and Their Applications in Large-Scale Data Analysis," invited key-note speaker, Algorithms for Big Data, Frankfurt, Germany, 2014
- "Invertible Bloom Lookup Tables and Their Applications in Large-Scale Data Analysis," Brown University, Providence, RI, 2014
- "Studying Road Networks Through an Algorithmic Lens," Bold Aspirations Visitor and Lecture, University of Kansas, 2015
- "Learning Character Strings via Mastermind Queries, with Case Studies," Invited Lecture, Workshop on Pattern Matching, Data Structures and Compression, Bar-Ilan University, Tel Aviv, Israel, 2016
- "Invertible Bloom Lookup Tables and Their Applications in Data Analysis," University of Hawaii, 2016
- "Invertible Bloom Lookup Tables," Purdue University, 2016
- "Combinatorial Pair Testing: Distinguishing Workers from Slackers," Calvin Univ., 2016
- "Invertible Bloom Lookup Tables," University of California, Riverside, 2016
- "2-3 Cuckoo Filters for Faster Triangle Listing and Set Intersection," Technion, Israel Institute of Technology, Haifa, Israel, 2017
- "2-3 Cuckoo Filters for Faster Triangle Listing and Set Intersection," University of Arizona, 2017
- "Parallel Computational Geometry," First Hawaii Workshop on Parallel Algorithms and Data Structures, University of Hawaii, 2017
- "Fighting Gerrymandering with Algorithmic Fairness," Calvin University, 2019
- "Fighting Gerrymandering with Algorithmic Fairness," Carnegie Mellon University, 2019
- "Sorting Evolving Data in Parallel," Second Hawaii Workshop on Parallel Algorithms and Data Structures, University of Hawaii, 2019
- "Dealing with Big Data via External Memory Algorithms and Data Structures," Aarhus University, Denmark, 2021
- "Dealing with Big Data via External Memory Algorithms and Data Structures," Royal Danish Academy of Sciences and Letters, 2021
- "Augmenting Networks for Greedy Routing," Dept. of Electrical and Computer Engineering, Distinguished Lecturer Series, Iowa State University, Dec. 2023.
- "Augmenting Networks for Greedy Routing," Dept. of Computer Science, University of

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California, Riverside, June 2024.

TECHNICAL EXPERT CONSULTING SUMMARY
(LAST FIVE YEARS)

Michael T. Goodrich, PhD

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TECHNICAL EXPERT CONSULTING

The following is a listing of prior and current expert consulting since 2019, where I have testified as an expert, but it may not include confidential information, as per written agreements.

1. Apr. 2016 to Sep. 2024, Technical expert and deponent, retained through Kramer Levin LLP on behalf of Acceleration Bay LLC, in IPR proceedings and patent litigation, Acceleration Bay LLC v. Activision Bizzard, Inc., Electronic Arts Inc., Take-Two Interactive Software, Inc., Rockstar Games, Inc., and 2K Sports, Inc. Civil Actions No. 1:16-cv-00453-RGA, No. 1:16-cv-00454-RGA, No. 1:16-cv-00455-RGA (D. Del.), IPR2015-01951, IPR2015-01953, IPR2015-01964, IPR2015-01970, IPR2015-01972, IPR2015-01996, IPR2016-00724, and IPR2016-00747 (PTAB).

2. May 2016 to Apr. 2023, Technical expert and deponent, retained through Kramer Levin LLP (transferred to Fish & Richardson) on behalf of Finjan, Inc., in PTO proceedings and patent litigations, Finjan, Inc. v. Blue Coat, Finjan, Inc. v. ESET, LLC, Finjan, Inc. v. Juniper Networks, Inc., Finjan, Inc. v. Cisco Systems, Inc., Finjan, Inc. v. Qualys, Inc., Finjan, Inc. v. Rapid7, Inc., and Finjan, Inc. v. SonicWall, Inc., IPR2015-01974, IPR2015-01979, IPR2016-00478, IPR2016-00159 (PTAB), 5:15-cv-03295-BLF-PSG (N.D. Cal.), 3:17-cv-05659-WHA (N.D. Cal.), 3:17-cv-0183-CAB-BGS (S.D. Cal.), 17-cv-0072-BLF-SVK (N.D. Cal.), 4:18-cv-07229-YGR (N.D. Cal.), 1:18cv-01519-MN (Del.), and 5:17-cv-04467-BLF (N.D. Cal.).

3. Jan. 2017 to Jan. 2021, Technical expert and deponent, retained by Fitzpatrick, Cella, Harper & Scinto, Venable LLP, on behalf of Koninklijke Philips N.V. and U.S. Philips Corp., in patent litigation, Philips v. Acer Inc., ASUSTeK Computer, Double Power Tech., HTC, Southern Telecom, Visual Land, Zowee Marketing Co., Ltd., Shenzen Zowee Technology Co., Ltd., YiFang USA, Inc. d/b/a EFun, Inc., and Intervenor/Counterclaim Defendant Microsoft Corporation. Civil Actions No. 15-1125-GMS, No. 15-1126-GMS, No. 15-1127-GMS, No. 15-1128-GMS, No. 15-1130-GMS, No. 15-1131-GMS, No. 15-1170-GMS (D. Del.), and 4:18-cv-01885-HSG (N.D. Cal., Oakland Div.).

4. Jun. 2018 to present, Technical expert, declarant, deponent, and testifying trial expert witness, retained through Kramer Levin LLP on behalf of Centripetal Networks, Inc., in IPRs

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and patent litigation, Centripetal Networks, Inc. v. Keysight Technologies, Inc., Ixia, and Cisco. Civil Actions No. 2:17-cv-00383/HCM-LRL and 2:18-cv-00094-HCM-LRL (E.D. Virginia), 2:22-cv-00002 (E.D. Virginia), IPR2018-01386, IPR2018-01443, IPR2018-01444, IPR2018-01512, IPR2018-01513, IPR2022-01525, IPR2023-00445, IPR2023-00446, IPR2023-00448 (PTAB), and Inv. No. 337-TA-1314 (ITC).

5. Feb. 2019 to present, Technical expert, declarant, deponent, and testifying trial expert witness, retained through Reichman Jorgensen LLP on behalf of Kove IO, Inc., in patent litigation, Kove IO, Inc. v. Amazon Web Services, Inc., Civil Action No. 1:18-cv-08175 (N.D. Illinois, Eastern Div.).

6. Apr. 2019 to Sep. 2020, Technical expert, declarant, and deponent, retained by McKool Smith on behalf of SEVEN Networks LLC in patent litigation, SEVEN Networks LLC v. Apple, Inc. Civil Action No. 2:19-cv-115 (E.D. Texas).

7. Jun. 2019 to Jun. 2023, Technical expert, declarant, and deponent, retained through Kramer Levin LLP on behalf of CUPP Cybersecurity LLC, in patent litigation, CUPP Cybersecurity LLC, et al., v. Trend Micro, Inc. IPR2021-00813, IPR2021-01236, IPR2021-01237 (PTAB), Civil Action no. 3:18-cv-01251-M, 3:20-cv-03206-M (N.D. Texas).

8. Jul. 2020 to Feb. 2021, Technical expert and declarant, retained through Goodwin Procter LLP on behalf of MobileIron, Inc., in patent litigation, MobileIron, Inc. v. BlackBerry Corp. IPR2020-01741 (PTAB).

9. Aug. 2020 to present, Technical expert and declarant, retained through Thompson & Knight LLP (now Holland & Knight) on behalf of Broadcom Corp., in patent litigation, Broadcom Corp. and Avago Technologies International Sales PTE. Limited v. Netflix, Inc. Civil actions no. 8:20-cv-529 (C.D. Cal.), 3:20-cv-04677-JD (N.D. Cal.).

10. Nov. 2020 to Dec. 2021, Technical expert and deponent, retained through Kramer Levin LLP on behalf of Midwest Athletics and Sports Alliance LLC (MASA), in patent litigation, Midwest Athletics and Sports Alliance LLC v. RICOH USA, Inc., and Midwest Athletics and Sports Alliance LLC v. Xerox Corp. Civil Action Nos. 19-CV-00514 (E.D. Penn.) and 6:19-CV-06036-EAW-JFW (W.D. New York).

11. Mar. 2021 to Feb. 2024, Technical expert, declarant, and deponent, retained through Nix Patterson LLP on behalf of Ikorongo Technology LLC, in patent litigation, Ikorongo v. Samsung, LG, Lyft, Uber, and Bumble Trading, Civil Action Nos. 6:20-cv-00256-ADA, 6:20-cv-00257-ADA, 6:20-cv-00258-ADA, 6:20-cv-00259-ADA, 6:20-cv-00843-ADA (W.D. Texas, Waco), and IPR2021-00204 (PTAB).

12. May 2021 to Aug. 2024, Technical expert, declarant, and deponent, retained by McKool Smith on behalf of SEVEN Networks LLC in patent litigation, SEVEN Networks, LLC v. Motorola Mobility LLC. Civil Action Nos. 2:21-cv-88 (E.D. Texas) and 3:21-cv-1036 (N.D. Texas).

13. Aug. 2021 to present, Technical expert, declarant, and deponent, retained through Holland & Knight LLP on behalf of CA, Inc., in patent litigation, CA, Inc. and Avago Technologies International Sales PTE. Limited v. Netflix, Inc. Civil action no. 2:21-cv-00080-JRG-RSP (E.D. Texas).

14. Aug. 2021 to present, Technical expert, declarant, deponent, and testifying trial expert witness, retained through Kramer Levin LLP on behalf of Centripetal Networks, Inc., in patent litigation and IPRs, Centripetal Networks, Inc. v. Palo Alto Networks, Inc. Civil Action No. 2:21-cv-00137 (E.D. Virginia, Norfolk Div.), IPR2021-01149, IPR2021-01150, IPR2021-01152, IPR2021-01157, IPR2022-00182 (PTAB).

15. Jul. 2022 to May 2024, Technical expert, deponant, and declarant, retained through McKool Smith on behalf of the State of Texas, in litigation State of Texas v. Meta Platforms, Inc., Cause No. 22-0121.

16. Aug. 2022 to present, Technical expert and declarant, retained through Stamoulis & Weinblatt LLC on behalf of Ameranth, Inc., in a patent-related matter.

17. Sep. 2022 to present, Technical expert, deponent, and declarant, retained through Reichman Jorgensen Lehman & Feldberg LLP on behalf of VideoLabs, Inc., in patent-related matters, VideoLabs v. Netflix, and Starz Entertainment, LLC, et al. v. VL Collective IP, LLC and VideoLabs, Inc., Civil Action No. 21-cv-1448-JLH (D. Del.), IPR2022-01086, IPR2023-00628, IPR2023-00630, IPR2023-00891.

18. Nov. 2022 to Jun. 2023, Technical expert and declarant, retained through McKool Smith on behalf of American Airlines, Inc., in a patent-related litigation, R2 Solutions LLC v. American Airlines, Inc., Civil Action No.4:22-cv-00353 (E.D. Tex.).

19. Feb. 2023 to Nov. 2023, Technical expert and declarant, retained through Kirkland and Ellis LLP on behalf of Forcepoint LLC in a patent-related litigation, Webroot, Inc. et al. v. Forcepoint LLC, Case No. 6:22-cv-00341-ADA (W.D. Tex.).

20. Feb. 2023 to Dec. 2023, Technical expert and declarant, retained through Holland & Knight LLP on behalf of MDSave Shared Services, Inc., in a patent-related litigation.

21. Aug. 2023 to Sep. 2024, Technical expert, declarant, and deponent, retained though Kramer Levin LLP on behalf of Acceleration Bay LLC in patent-related litigation, Acceleration Bay LLC v. Amazon Web Services, Inc., Case No. 1:22-cv-904 (D. Del.).

22. Feb. 2024 to May 2024, Technical expert and declarant, retained through McKool Smith on behalf of AlphaSense, Inc., in patent litigation, AlphaSense, Oy and AlphaSense, Inc. v. Tegus, Inc. and Bamsec, LLC, Case No. cv-23-1030-MN (D. Del.).

23. May 2024 to present, Technical expert and declarant, retained through Reichman Jorgensen Lehman & Feldberg LLP on behalf of Kove IO, Inc., in patent litigation, Kove IO, Inc. v. Google, LLC, No. 1:23-cv-04244 (N.D. Ill.).

24. July 2024 to present, Technical expert and declarant, retained through McKool Smith on behalf of Carbyne Biometrics, LLC, in patent litigation, Apple, Inc., Petitioner v. Carbyne Biometrics, LLC, Patent Owner in Case: (1) IPR2024-00329, U.S. Patent No. 9,972,010; (2) IPR2024-00330, U.S. Patent No. 10,713,656; (3) IPR2024-00331, U.S. Patent No. 11,526,886; (4) IPR2024-00332, U.S. Patent No. 10,929,512; (5) IPR2024-00333, U.S. Patent No. 11,475,105; (6) IPR2024-00334, U.S. Patent No. 11,514,138; and (7) IPR2024-00507, U.S. Patent No. 11,475,105.

25. October 2024 to present, Technical expert, retained through Kramer Levin LLP on behalf of Cyandia, Inc., in patent litigation Cyandia, Inc. v. SAP America, Inc., and SAP SE, Case No. 2:22-cv-00096-JRG.