UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AYLO FREESITES LTD,
Petitioner
v.

DISH TECHNOLOGIES L.L.C.,
Patent Owner

U.S. Patent 11,991,234
Issue Date: May 21, 2024
Title: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Inter Partes Review No. IPR2024-00941

DECLARATION OF HENRY HOUH, Ph.D. IN SUPPORT OF PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 11,991,234

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I, Henry Houh, Ph.D., declare as follows:

I. INTRODUCTION

1. My name is Henry Houh, and I have been retained by counsel for Aylo Freesites, Ltd ("Petitioner") to analyze U.S. Patent No. 11,991,234 ("'234 Patent") (EX1001) and to provide my opinions regarding the patentability of 1-20 of the '234 Patent.

2. I am being compensated at my normal consulting rate of $650 per hour for my time. My compensation is not contingent on the outcome of this proceeding, or of any proceedings relating to the '234 Patent.

II. BACKGROUND AND QUALIFICATIONS

3. I am currently employed by Houh Consulting Inc. as an independent technical consultant. Until October 2022, I also worked as the co-founder of Einstein's Workshop, a company that provides supplemental science, technology, engineering, and mathematics ("STEM") education to children of all ages. I also co-founded and serve on the board of BlocksCAD, Inc., which provides educational computer-aided design software used around the world.

4. My professional career has spanned more than 25 years. As set forth in my curriculum vitae (attached as Exhibit A to this declaration), during these years I have gained extensive experience in web sites, communications systems,

networking, distributed systems, protocols and streaming audio/video communications.

5. I have multiple undergraduate and graduate degrees from the Massachusetts Institute of Technology (MIT). I have a Bachelor of Science Degree in Electrical Engineering and Computer Science from MIT which I received in June 1989. I also have a Bachelor of Science Degree in Physics from MIT which I received in February 1990. I have a Master of Science Degree in Electrical Engineering and Computer Science from MIT which I received in February 1991. I have a PhD in Electrical Engineering and Computer Science from MIT which I received in February 1998. My thesis was directed to "Designing Networks for Tomorrow's Traffic," and was supervised by Professor David Tennenhouse and Professor John Guttag.

6. I first worked in the area of communications in 1987 when I worked at AT&T Bell Laboratories as part of a five-year dual degree program at MIT. At Bell Labs, I first worked in a group supporting core telephony switching functions, then later I joined the Optical Computing group. In graduate school, I joined the Advanced Network Architecture (ANA) group at the Laboratory for Computer Science (LCS) at MIT, then headed by Prof. Tennenhouse and senior research scientist David Clark. Dr. Clark is generally considered to be one of the fathers of

the Internet Protocol, having acted as chief protocol architect for the development of the Internet. My research and work experience in distributed systems, networking, and network architecture dates back to around 1991 when I joined ANA.

7. Later, when Prof. Tennenhouse formed his own research group, the Telemedia Network Systems (TNS) group, I joined TNS. The TNS group built a high-speed gigabit network and applications which ran over the network, such as remote video capture, processing, and display on computer terminals. I designed the core networking hardware and software, including the high-speed data links and the device drivers for the network interface cards.

8. TNS's research activities focused on high-speed networking and the types of applications that require increased network bandwidth and computing power. One of the applications I investigated was live streaming video, and real-time processing of such video. My work was focused on the transport, switching, and routing of data (including video and audio streams), and the integration of TNS's network into the computing environment, including the protocols, IP/ATM integration, operating system software and device drivers. TNS created a computing environment where it was possible to stream audio/video live, and also created software processing modules to further process video to perform advanced functions such as green screening, scene change detection, motion detection, compression,

video blending and video overlay, among many other features – all in real-time while displaying the processed video live. Our system also had the capability to identify a frame within video files, so that the video could be started at a particular point within the video. While the Internet at the time did not have the capability for such applications to be widely deployed, my group at TNS researched what would be possible when the required network and computing power became available. As discussed above, my Ph.D. thesis work focused on studying the routing resources required to route streams of video through the network, proposing several alternative labeling strategies to speed up network routing, especially for popular applications such as web traffic.

9. During the early part of my graduate studies, a time when there were perhaps a hundred or so web servers in existence, I set up a web server on one of our lab computers, and created content rich web pages for my research group and my research activities. Eventually, I, together with others I was working with, added live video demonstrations to TNS's web site. TNS's web site was one of the first several hundred web servers to exist, and the first to offer live video demonstrations initiated from the web site to a user's remote computer. I helped to build the web pages that initiated these video sessions via a web interface. I started and maintained the "Commercial Sites Index," the first listing of all the companies on the web. I later

sold this list to OpenMarket, then a leader in web servers and eCommerce servers. I also started a company to build web sites and sell targeted online advertisements. During this time, I followed the evolution of the web very closely.

10. Vice-President Al Gore visited our group in 1996 and received a demonstration of – and remotely drove – a radio controlled toy car with a wireless video camera mounted on it; the video was encoded by TNS-designed hardware, streamed over the TNS-designed network and displayed using TNS-designed software.

11. I authored or co-authored at least twelve papers and conference presentations on my group's research at TNS. I also co-edited TNS's final report on its gigabit networking research effort. Some of my papers about web site development were presented at the first World-Wide Web conference held in 1994 at CERN in Geneva, Switzerland. CERN is the birthplace of the Web, and the conference was chaired by Tim Berners-Lee, the inventor of the World-Wide Web. When Tim Berners-Lee formed the World Wide Web Consortium at the MIT LCS in order to manage the progression of web protocols and standards, I assisted him in obtaining the consortium's domain names and setting up the consortium's web server.

12. I have extensive experience in creating web pages and commercially setting up websites during the 1993-1997 time frame, and have continued this development since then. As part of this experience, I regularly programmed using HTML and Perl programming languages. I also have experience with CGI scripts and Perl scripts as used for dynamic web pages.

13. From 1997 to 1999, I was a Senior Scientist and Engineer at NBX Corporation, a start-up that made business telephone systems for streaming packetized audio over data networks instead of using traditional telephone lines. NBX was later acquired by 3Com Corporation, and the phone system I worked on at NBX was widely used by numerous businesses. As part of my work at NBX, I designed the core audio reconstruction algorithms for the telephones, as well as the packet transmission algorithms. I also designed and validated the core packet transport protocol used by the phone system.

14. Two of the company founders and I obtained U.S. Patent No. 6,967,963, entitled "Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data," as a result of part of the work I did at NBX.

15. From 2003-2004, I also was the architect for a next-generation web testing platform developed by Empirix, known as e-Test Suite. E-Test Suite is now owned by Oracle Corporation. E-Test provided functional and load testing for web

sites. E-Test emulated a user's interaction with a web site and provided web developers with a method of creating various scripts and providing both functional testing (i.e., did the web site provide the correct response) and load testing (i.e., could the web site handle 5000 users simultaneously). As part of this project, I co-wrote a javascript interpreter for e-Test so that it could understand the javascript code present on advanced web sites.

16. I worked at BBN Technologies from 2004 to 2009. BBN Technologies, formerly known as Bolt, Beranek and Newman, was a pioneer of the Internet and a long-established leader in speech recognition and natural language processing. BBN received the first contract to build components of a packet switched network as part of the ARPANET, a U.S. Department of Defense effort funded through the Advanced Projects Research Agency (ARPA). While this effort preceded my time at BBN by many years, BBN continued to maintain a strong presence in network research and development, including in wireless networking, device discovery, and protocols for a "body area network."

17. In 2006, as part of my role at BBN Technologies, I helped found PodZinger Inc., now known as RAMP Inc. PodZinger utilized BBN's speech recognition algorithms to search through the spoken words inside audio and video. After managing the creation of the initial prototype system, PodZinger built out a

full web-based streaming audio and video search solution when I was the Vice President of Operations and Technology there. The web site had a full load- balanced back end that provided search and indexing solutions for our hosted multimedia (audio and video) content. Our PodZinger system processed videos in order to perform automatic speech recognition on the spoken contents of the video, after which we produced a word transcript we used in a search index for all our processed videos. All of the words in the transcript were individually tagged to frame locations within the video, so that selecting a word in the transcript caused the video to jump to the location within the video at which the word was spoken. For this work and more, we received a patent, on which I was an inventor – U.S. Patent No. 7,801,910, titled "Method and apparatus for timed tagging of media content." In addition, we received several more patents on which I was an inventor, including U.S. Patent No. 9,697,231, titled "Methods and apparatus for providing virtual media channels based on media search," and U.S. Patent No. 9,697,230, titled "Methods and apparatus for dynamic presentation of advertising, factual, and informational content using enhanced metadata in search-driven media applications." These patents described computerized method and apparatus for merging video content segments from discrete media content for playback, and using metadata extracted from multimedia content segments to display additional information, such as advertisements, adjacent

to the media player, while tracking the progression of the playback and changing the information as playback progressed through various segments to correspond to the content of the segments.

18. I also worked on commercializing a service offered by BBN to monitor call centers and provide analytical data on each call. The business became known as AVOKE Analytics and provided call center analytics for large organizations such as Dell and the Centers for Medicare and Medicaid Services (CMMS). For a time, during the rollout of the Affordable Care Act (though I was no longer working at BBN), AVOKE Analytics gathered data and provided call-by-call analytics for every call made to the CMMS main call center.

19. I have web advertising experience as well, including starting a company in 1994 that was funded, in part, through web advertisements. Later in 2008-2009, as the CTO of a venture-funded social network start-up company, I also evaluated different advertising network tools which were used in the roll-out of an advertising network.

20. I am familiar with patents and have numerous provisional and non-provisional patent applications on which I am an inventor, including 4 provisional patent applications, and around 20 non-provisional applications. These patent applications deal with various areas of technology including, but not limited to:

utilizing network processors, network and packet delivery systems, tagging media content, dynamic presentation of advertising and other content using enhanced metadata, methods for web site testing, and organizing and managing files that are transmitted over a network.

III. MATERIALS CONSIDERED

21. In preparing this declaration, I reviewed the ’234 Patent, including the claims of the patent in view of the specification, and I have reviewed the prosecution history of the ’234 Patent and numerous prior art and technical references from the time of the alleged invention. Of the materials cited as an exhibit to the ’234 Patent IPR petition, I reviewed the following:

Exhibit	Description
1001	U.S. Pat. 11,991,234 (“the ’234 Patent”)
1002	File History of the ’234 Patent
1004	U.S. Patent No. 6,161,137 to Ogdon et al. (“Ogdon”)
1005	International P.C.T. Publication WO 2002/075482 A2 (“Allen”)
1006	U.S. Patent Publication No. 2003/0236906 to Klements (“Klements”)
1007	U.S. Patent No. 6,848,004 to Chang (“Chang”)
1008	WO1997044942 to Kliger (“Kliger”)
1009	337-TA-1265 ITC Investigation Initial Determination

1010	337-TA-1265 ITC September 11, 2023 Enforcement Complaint
1011	Internet Archive Affidavit for URLs including EX1019
1012	Gourley, David, and Brian Totty. HTTP: the definitive guide. O'Reilly Media, Inc., 2002 ("Gourley"). available at https://archive.org/details/httpdefinitivegu00gour/page/n1/mode/2up.
1013	Patent Owner Preliminary Response in IPR2024-00514
1014	DISH May 7, 2024 letter in support of its motion for leave to file first amended complaint in *DISH Technologies L.L.C. et. Al. v. fuboTV Media Inc*., 1:23-cv-00986-GBW (D. Del.)
1015	Excerpted transcript from March 27, 2024 hearing at United Kingdom High Court of Justice in *DISH Technologies, L.L.C. et al. v. Aylo Premium Ltd et al*., Claim No. HP-2023-000043
1016	File History of U.S. Pat. No. 11,470,138 ("'138 Patent")
1017	Petition for IPR in IPR2024-00044
1018	File History of U.S. Pat. No. 8,868,772
1019	HTTP 1.1 Protocol - RCF2616 (https://web.archive.org/web/20020802040147/https://www.ietf.org/rfc/rfc2616.txt)
1020	U.S. Patent Publication No. 2004/0093420 to Gamble ("Gamble")
1021	File History of U.S. Pat. 6,161,137 to Ogdon
1022	U.S. Provisional Application No. 60/041,770 ("Ogdon Provisional")
1023	U.S. Patent No. 6,637,031 to Chou ("Chou")

22. Petitioner's counsel has asked me to consider whether certain references disclose or suggest, alone or in combination, the features recited in certain claims of the '234 Patent. I have also been asked to consider the state of the art and the prior art available before the time of the alleged invention of the '234 Patent. My opinions are provided in this declaration.

23. My opinions in this declaration are based on my review of the documents above, my understanding as an expert in the relevant field, and my education, training, research, knowledge, and personal and professional experience.

24. To my knowledge, I have no financial interest in Petitioner. Counsel for Petitioner has informed me that DISH Technologies, L.L.C. purports to own the '234 Patent and that Sling TV L.L.C. purports to be an exclusive licensee of the '234 Patent. To the best of my knowledge, I have no financial interest in DISH Technologies L.L.C. or Sling TV L.L.C and, to my recollection, have had no contact with DISH Technologies L.L.C. or Sling TV L.L.C or the named inventors of the '234 Patent. To the best of my knowledge, I do not have any financial interest in the '234 Patent.

25. To the extent any mutual funds or other investments that I own have a financial interest in the Petitioner, the Patent Owner, or the '234 Patent, I am not

aware of, and do not control, any financial interest that would affect or bias my judgment.

IV. LEGAL STANDARDS

26. Petitioner's counsel has informed me that, in an *inter partes* review proceeding, a patent claim may be deemed unpatentable if it is shown by a preponderance of the evidence that the claim was either anticipated by a prior art patent or publication or rendered obvious by one or more prior art patents or publications.

27. Petitioner's counsel has informed me that a claim is unpatentable if the differences between the subject matter of the patent and the prior art are such that the subject matter as a whole would have been obvious to a person of ordinary skill in the art, or a "POSITA", at the time of the invention.

28. Petitioner's counsel has informed me that a determination of whether a claim would have been obvious should be based upon several factors, including the following:

- The level of ordinary skill in the art at the time the application was filed;
- The scope and content of the prior art; and
- What differences, if any, existed between the claimed invention and the prior art.

29. Petitioner's counsel has informed me that a single reference can render a patent claim obvious if any differences between that reference and the claims would have been obvious to a person of ordinary skill in the art. Alternatively, the teachings of two or more references may be combined in the same way as disclosed in the claims, if such a combination would have been obvious to one having ordinary skill in the art. In determining whether a combination based on either a single reference or multiple references would have been obvious, I understand from Petitioner's counsel that it is appropriate to consider the following factors:

- Whether the teachings of the prior art references disclose known concepts combined in familiar ways, and when combined, would yield predictable results;
- Whether a POSITA could implement a predictable variation, and would see the benefit of doing so;
- Whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by those skilled in the art;
- Whether a person of ordinary skill would have recognized a reason to combine known elements in the manner described in the claim;

- Whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and
- Whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.

30. Petitioner's counsel has informed me that a POSITA has ordinary creativity and is not an automaton.

31. Petitioner's counsel has informed me that all prior art references are to be looked at from the viewpoint of a POSITA.

32. Petitioner's counsel has informed me that, in considering obviousness, it is important not to determine obviousness using the benefit of hindsight derived from the patent being considered, and that obviousness is analyzed from the perspective of a POSITA at the time of the invention.

V. OVERVIEW OF THE '234 PATENT

33. The '234 Patent (Application No. 18/069,450) was filed on December 21, 2022. The '234 Patent purports to relate to "multi-bitrate content streaming," such as video, over the Internet. EX1001, Abstract, 1:35-38. The '234 Patent describes "a receiving module" to "capture media content," a streamlet module to "segment the media content and generate a plurality of streamlets," and "encoding module" to "generate a set of streamlets" such that the set of streamlets has a

plurality of streamlets "having identical time indices and durations" and "a unique bitrate." *Id.*, Abstract.

34. One embodiment of the system of the '234 Patent includes "a content server 102" and "end user 104" coupled by a data communications network (*e.g.*, the Internet 106) wherein the "end user station 104" may be a personal computer, entertainment system, or a portable electronic device configured to present content. *Id.*, FIG. 1, 6:39-50. The '234 Patent describes encoding the same content file 200 into at least three different "quality" streams:

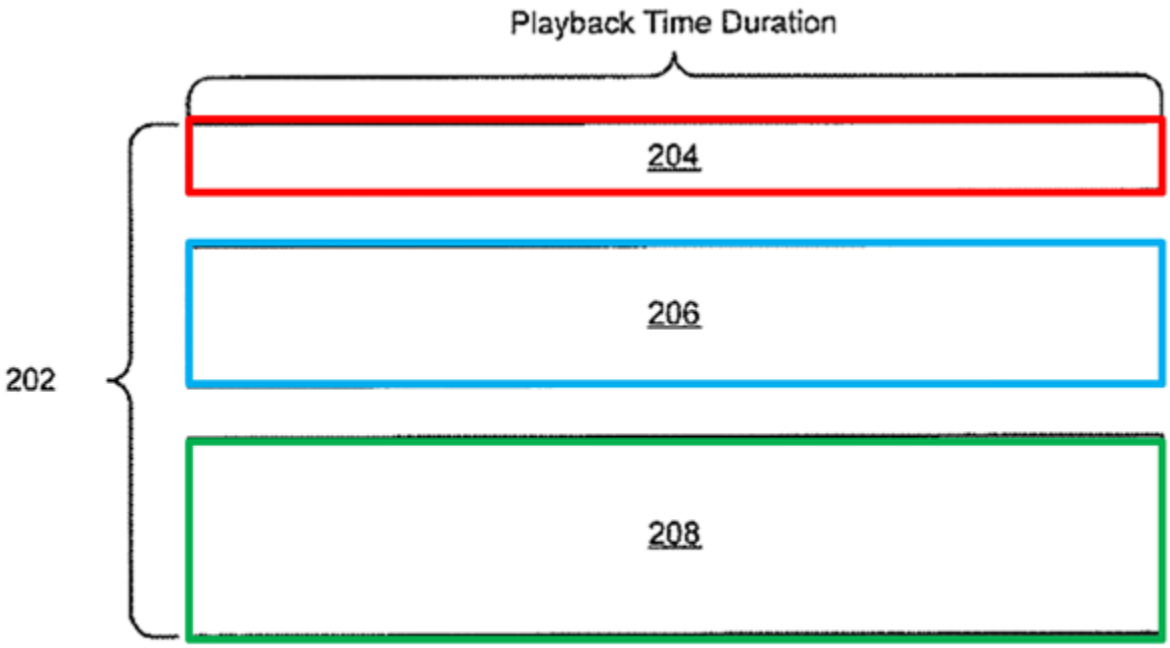


FIG. 2b

Id., FIG. 2b (annotated, low quality (red, 204), medium quality (blue, 206), and high quality (green, 208)), 7:25-31.

35. For example, "low quality stream 204 may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream 206 may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream 208 may be encoded and compressed to 600 kbps." *Id.*, 7:33-39. Each stream (204, 206, and 208) is also "divided into a plurality of source streamlets 303" where "streamlet refers to any sized portion of the content file" and may be "an independent media object" where "streamlet 0 may have a time index of 00:00 representing the beginning of content playback, and streamlet 1 may have a time index of 00:02, and so on." *Id.*, 7:39-52.

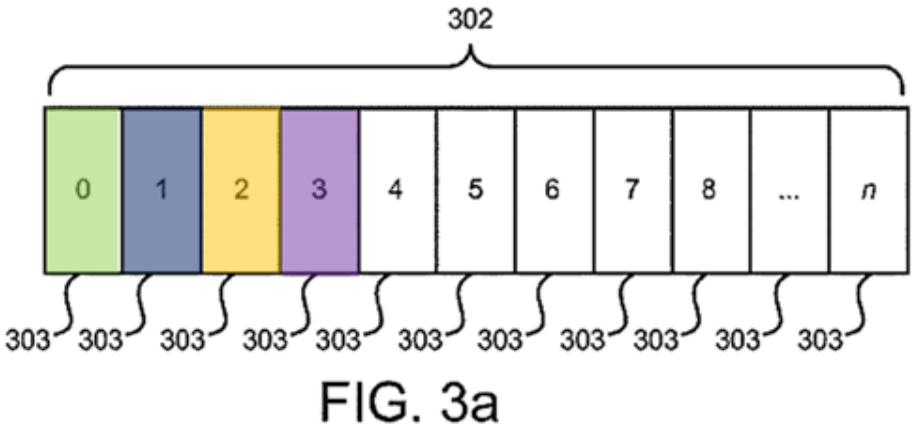


FIG. 3a

Id., FIG. 3a (annotated).

36. These streamlets form "sets" of streamlets 306 wherein a "set" is "a group of streamlets having identical time indices and durations but varying bitrates." *Id.*, 7:60-62.

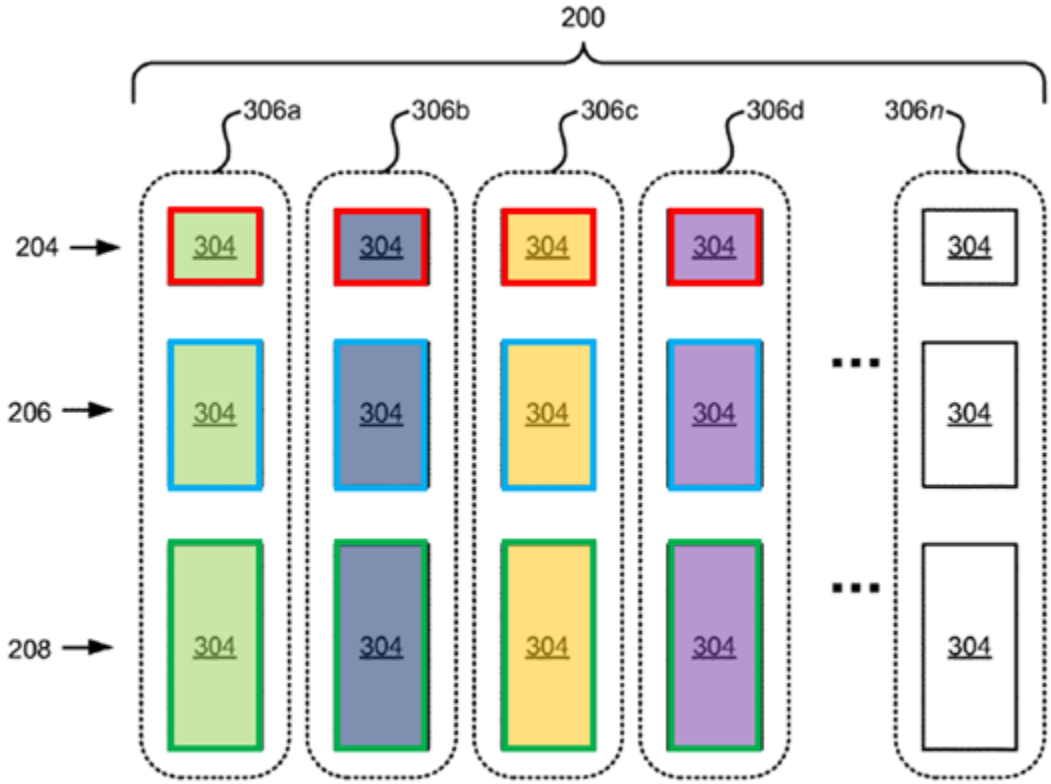


FIG. 3b

Id., FIG. 3b (annotated, showing low, medium, and high quality streamlets in each "set" of streamlets" 306a-d).

37. These sets of streamlets are stored in a streamlet database 408 and then a "client module 114 may request streamlets 304 using HTTP from the web server 116" or "a plurality of web servers 116." *Id.*, 9:4-7, 9:34-44.

38. To stream content, the client module 114's "agent controller module 702 is configured to select a quality level of streamlets to transmit to the viewer" and "requests lower or higher quality streams based upon continuous observation of time intervals between successive receive times of each requested streamlet." *Id.*, 13:9-33. The "agent controller module 702 receives 1004 a streamlet" and "monitors 1006 the receive time of the requested streamlet" such as time intervals between successive receive times for each streamlet response and "calculates 1008 a performance ratio" and "obtain[s] a performance factor." *Id.*, 17:6-44, FIGs. 9 and 10. The agent control module determines whether to upshift or downshift the stream quality based upon comparing the performance factor versus trigger thresholds and makes a "determination of whether use of the higher quality stream is sustainable." *Id.*, 17:44-18:17.

A. Prosecution History

I understand that the '234 Patent was filed as Application No. 18/069,450 on December 21, 2022. In the first office action on March 16, 2023, the Examiner rejected claims 1-10 over prior art combinations including Jacobs (US 2004/0172478), Carmel (US 6,389,473), Lee (US 7,996,450), Pulier (US 2002/0091840), Omoigui (US 7,096,271), and Lu (US 2008/0225959). EX1002, 186-201. The examiner rejected claims 11 and 22 under nonstatutory double

patenting over claims of U.S. Patent No. 8,868,772 in view of (Carmel US 6,389,473). *Id.* In that same first office action, the Examiner indicated that claims 11-30 were allowable, stating "[a] thorough review of the prior art teaches portions of the claim language with respect to client-side monitoring of the ability to receive the streamlet at the current bitrate, the client adjusting the higher and lower bitrates based upon the determination and the parsing and encoding of the stream into a plurality of streamlets, it fails to disclose or render obvious, 'automatically requesting from the at least one server subsequent portions of the digital content by requesting for each subsequent portion one of the streamlets from the different copies of the digital content dependent upon successive determinations by the client module to change a currently requested bit rate to a higher or lower bit rate, the automatically requesting including repeatedly generating a factor indicative of a current ability to receive digital content at a rate sufficient for presenting the digital content as the digital content is received; making the successive determinations to change the digital content bit rate based on the factor using the streamlets of one of the different copies of the digital content having the highest bit rate determined receivable for presentation so that the client module selects a higher bit rate one of the different copies when the factor is greater than a first threshold and selects a

lower bit rate one of the different copies when the factor is less than a second threshold.'" EX1002, 201.

39. In response, Applicant canceled claims 1-10 and filed a terminal disclaimer. EX1002, 327-342. The Examiner then issued a notice of allowance reciting the same reasons for allowance on July 14, 2023. EX1002, 356-358. On August 21, 2023, the Examiner contacted Applicant's representative to inform him that claim 22 of the instant application had an additional nonstatutory double patenting rejection over U.S. Patent No. 9,407,564 in view of Carmel (EX1002, 389) and Applicant promptly filed another terminal disclaimer (*id.*, 381). Applicant filed an RCE on October 19, 2023 and submitted multiple lengthy IDSs in total listing 670 references including Petitioner's prior IPR petitions and supporting declarations for related patents over base prior art reference Ogdon (U.S. 6,161,137). EX1002, 397-621. Shortly thereafter on November 30, 2023, the Examiner issued another Notice of Allowance with no reasons for allowance and simply checking the IDS box on the form and stamping "all references considered" for the lengthy IDSs. EX1002, 657. On February 1, 2024, Applicant filed another RCE and submitted an additional IDS citing for the first time the Leaning reference (the primary reference in this Petition) and the Leaning-based IPR petitions Petitioner filed against related patents. EX1002, 1001-1006. On March 25, 2024, the Examiner issued yet another

Notice of Allowance again providing no reasons for allowance and simply stamping "all references considered" and checking the IDS box on the Notice of Allowance form. EX1002, 1018. Well-after the issue fee was paid ***on the day before the '234 Patent issued***, Applicant filed an IDS without a certification statement and submitted fuboTV's and Yanka Industries' IPR petitions and the Board's institution decisions granting institution of IPRs of related patents. *Id.*, 1411-1420.

B. Priority Date

40. I do not offer any opinion as to whether the '234 Patent can claim a priority date of April 30, 2004 (the "Priority Date") based on the claimed priority to the Provisional application No. 60/566,831. For the purposes of this analysis I assume the Priority Date is April 30, 2004.

VI. LEVEL OF ORDINARY SKILL IN THE ART

41. In my opinion, a person having ordinary skill in the art ("POSITA") as of the Priority Date would have had at least a B.S. degree in computer science or electrical engineering (or comparable degree) and two years of experience in networking or streaming media, or a M.S. in computer science or electrical engineering (or comparable degree). A higher level of education or specific skill might make up for less experience, and vice-versa. I was a POSITA at the time of the Priority Date.

VII. CLAIM CONSTRUCTION

42. Petitioner's counsel has informed me that claims subject to *inter partes* review are construed according to the ordinary and customary meaning of the claim as understood by a POSITA and the prosecution history of the patent being construed.

43. For purposes of this declaration, I have applied the ordinary and customary meaning of the claims when read in light of the '234 Patent and the prosecution history of the '234 Patent, as understood by a POSITA at the time of the invention.

44. I understand that Family members of the '234 Patent were asserted in the International Trade Commission ("ITC") in Investigation No. 337-TA-1265 (ITC) ("the ITC Investigation"). I also understand that Petitioner was not involved in the ITC Investigation. I understand that that in the ITC Investigation between Patent Owner and iFIT Inc. asserting family members of the '234 Patent, the Chief Administrative Law Judge ("ALJ") construed "streamlet" as "any sized portion of the content file." EX1009, 38-43. And that the ALJ also construed "a factor indicative of the current ability to sustain the streaming [of the video … wherein the set of one or more factors relate to the performance of the network]" according to its plain and ordinary meaning, "*e.g.*, one or more factors relating to the performance

of the network that is indicative of an ability to sustain the streaming of the video." EX1009, 53-61. The ALJ also construed "repeatedly generating a factor" as "generating a factor more than once" and construed "successive determinations" according to its plain and ordinary meaning. *Id.*, 61-64.

45. In my opinion, the term "virtual timeline" may require construction. The '234 Patent describes a "virtual timeline" as "a file that is configured to define a playlist for a user to view" which "may indicate that the publisher desires a user to watch a first show QMX 602a followed by QMX 602b and QMX 602c" such that "the publisher may define a broadcast schedule in a manner similar to a television station." EX1001, 12:33-45, FIGs. 6a-6c. The '234 Patent further explains that the Quantum Media Extension (QMX) files each "describe an entire content file." *Id.,* 12:37-38. Thus, I propose construing "virtual timeline" as "a playlist of entire content files."

VIII. SUMMARY OF OPINIONS

46. In my opinion, claims 1-20 (the "Challenged Claims") of the '234 Patent are at least invalid as obvious to a POSITA as of the Priority Date. Here, I offer my opinion that (1) claims 1-8, 10-15, and 17-20 would at least have been obvious in view of Ogdon and Allen, (2) claim 9 would at least have been obvious

in view of Ogdon and Allen and Klements, and (3) claim 16 would at least have been obvious in view of Ogdon and Allen and Gamble.

47. This declaration reflects my opinions that I have formed to date, based on my review of the materials identified in Section III. I reserve the right to revise, supplement, or amend my opinions based on new information that becomes available to me, and by further continuing analysis of the materials identified in Section III.

A. State of the Art

48. The ’234 Patent admits in the “Description of Related Art” section that “streaming media” was known, including streaming of “audio/video” where “quality that can be received for real time presentation is constrained by the available bandwidth of the user’s network connection.” EX1001, 1:51-61. The ’234 Patent further admits that TCP connections were known and that “[m]ost streaming solutions use a TCP connection.” *Id.*, 2:5-50. The Patent admits that the HTTP protocol is “standard.” *Id.*, 9:36-37. Further, Patent Owner admits that the “standard HTTP/TCP protocol” is “the web standard upon which the Internet is built.” *See DISH Technologies LLC et al v. Aylo Premium Limited et al* Case No. 2:23-cv-00552, D.I. 1 at ¶ 30.

49. Before the Priority Date, “client-pull” streaming systems were known in the art wherein a client requested from a server sequential portions of a file at

different encoded quality levels based on network bandwidth. For example, Chang (filed in 1999) describes "real time measurement and prediction of bandwidth for adaptive content delivery of rich media according to available user bandwidth." EX1007, Abstract. Chang discloses a client (via java applets) that performs real time bandwidth measurement according to user's available bandwidth and fetches the corresponding bandwidth sensitive track content from the server via HTTP requests. *Id.*, 7:43-53, 8:59-9:5, 9:45-51, 10:15-14, 10:35-58. In another example, Kliger (filed in 1997) teaches a media player device that requests from a server the appropriate bandwidth object depending on network bandwidth. EX1008, 3:25-32, 5:25-28, 9:32-10:4, 12:33:13:8, claim 3.

B. Ogdon

50. Ogdon (EX1004) was filed on March 31, 1998 and issued on December 12, 2000. Ogdon is prior art under at least (pre-AIA) 35 U.S.C. § 102(b). Ogdon is cited on the face of the '234 Patent but was not used by the Examiner in any office action.

51. Ogdon discloses a system for distributing a video presentation, during the performance of the presentation, over the Internet via webservers to a plurality of client nodes at a quality level appropriate for each client node based upon the transmission characteristics of the network, such as data transmission rate. EX1004,

Abstract, 1:9-15, 2:21-35. Ogdon discloses that each video presentation includes a plurality of sequential presentation elements, collections, or subcollections of "one or more segments" where each segment has multiple versions of the same content and same duration at a different quality levels such that each version of each element can be substituted for the other as an alternative based upon network performance. *Id*., 2:36-66, 13:47-49. Ogdon further discloses that each client node selects and requests each sequential segment (or collection of segments) at the appropriate quality level based upon its calculated network characteristics. *Id*., 4:29-36, 6:40-51, 7:10-15, 21:40-45, 22:10-33, 23:40-24:3, 25:24-30.

C. Allen

52. Allen (EX1005) was filed on March 15, 2002 and published on September 26, 2002. Allen is prior art under at least (pre-AIA) 35 U.S.C. § 102(b). Allen is cited on the face of the '234 Patent but was not used by the Examiner in any office action.

53. Allen discloses streaming media to multiple users and tailoring the delivery stream to the capabilities of the user's system. EX1005, 1:15-21. Allen explains that multi-bitrate streaming was well-known, including encoding copies of a video at multiple quality levels with different bitrates, such as low quality (56 kbps), medium quality (300 kbps) and high quality (600 kbps). *Id.*, 12:1-5.

D. Klements

54. Klements (EX1006) was filed on June 24, 2002 and issued on December 25, 2003. Klements is prior art under at least (pre-AIA) 35 U.S.C. § 102(e). Klements is cited on the face of the '234 Patent but was not used by the Examiner in any office action.

55. Klements is related to client-side caching of streaming media. EX1006, ¶ [0001]. Klements discloses that such streaming media may be segmented into different "pieces" of content (*e.g.*, every five minutes of content is a piece") where "[e]ach piece of media content may include multiple streams . . . typically at a particular encoded bit rate. EX1006, ¶¶ [0036]-[0038]. These are "[m]ultiple versions of the same" content to "allow[] selection of different combinations of these streams for playback by [a client] media player." EX1006, ¶ [0039]. Klements further discloses grouping multiple pieces of content together in a "playlist" such that each "piece" (*e.g.*, 20 songs in a playlist) is streamed subsequently in succession. EX1006, ¶ [0041]. Klements' media player determines "the current available bandwidth" and requests the appropriate bit rate version based on this determination from the server. EX1006, ¶¶ [0045]-[0054].

E. Gamble

56. Gamble (EX1020) was filed on November 13, 2002 and published on May 13, 2004. Gamble is prior art under at least (pre-AIA) 35 U.S.C. § 102(e). Gamble is cited on the face of the ’234 Patent but was not used by the Examiner in any office action.

57. Gamble discloses transferring files over a plurality of parallel TCP connections between client and server. EX1020, Abstract, ¶ [0034], [0050]. Gamble further discloses a client application for receiving multiple subparts of stream files over a plurality of parallel TCP connections to a server. *Id*., ¶¶ [0034]-[0040], [0050]-[0052]. Gamble further discloses implementing TCP congestion protocols for the client. *Id*., ¶ [0052].

F. Analogous Art

58. Each prior art reference is analogous art to the claimed invention in the ’234 Patent. Each is in the same field of endeavor of streaming based on network conditions, with Ogdon teaching adaptive-rate streaming based on network conditions. *Compare* EX1001, title, Abstract, 1:35-38, 2:61-3:4, 3:5-4:36, FIGs. 2-7, *with* EX1004, Abstract, 1:9-15, 2:21-66, 13:47-49; EX1005, 1:15-21, 12:1-5; EX1006, ¶¶ [0001], [0036]-[0054]; EX1020, ¶¶ [0004]-[0005], [0050]-[0052].

59. Additionally, the prior art references are reasonably pertinent to any purported problem addressed in the '234 Patent, such as "alleviat[ing] the problems of reliability, efficiency, and latency" and "offer[ing] instantaneous viewing" using "multiple connections between a source and a destination" and/or "requesting varying bitrate streams depending upon network conditions" *Id.*; EX1001, 2:61-3:4.

G. Claims 1-8, 10-15 and 17-20 Would Have Been Obvious in view of Ogdon and Allen

Claim 1:

1[Pre]: "An end user station for adaptive-rate content streaming of digital content comprising:"

60. In my opinion, whether or not the preamble is limiting, Ogdon teaches 1[Pre]. Ogdon discloses an end user station (client node(s)) for streaming of digital content (video and/or audio) because Ogdon describes "[c]lient sites 52, where audience members receive a presentation . . . has at least one of a **client node 56**[1] (e.g., a personal computer)" and "may receive **video** (and possibly **audio** as well) information from a communications network 70 such as the **Internet.**" EX1005, 7:40-48. Ogdon further teaches that such streaming is adaptive-rate content

[1] All emphases in prior art citations are added unless otherwise indicated.

streaming because Ogdon describes that client nodes "**dynamically and adaptively switch** between . . . versions of the presentation according to network transmission characteristics at each client network node." EX1004, 3:38-41; *see also id.*, Abstract ("the client nodes receiving the presentation **determine a particular variation** of data presentation to receive from the network server nodes" depending on "characteristics of the network such as data transmission rate"), 8:27-40 ("content webservers 96a, and alternate content web servers 96b" provide "presentation data to client sites 54 requesting such data via client nodes").

1[A][1]: "a client module configured to be connected to a network having at least one server and further configured to request digital content over the network via at least one transmission control protocol (TCP) connection,"

61. In my opinion, Ogdon teaches 1[A][1]. Ogdon describes a client module, *i.e.* client presentation software 88 and/or browser 78 at the client node(s), that is configured to be connected to a network having at least one server (webservers 96) and further configured to request digital content (video and/or audio segments) over the network because as Ogdon explains, "**client presentation software system 88** [] coordinates with the **browser 78** for **requesting**, receiving and displaying presentation segments (from the network 70) as appropriate during the presentation." EX1004, 7:59-63, 8:27-40 ("content webservers 96a, and alternate content web

servers 96b" provide "presentation data to client sites 54 requesting such data via client nodes").

62. Ogdon further explains that such requesting of segments of digital content takes place over at least one transmission control protocol (TCP) connection because Ogdon describes that "the present invention may communicate the video portion of a presentation to a user site via the Internet (more generally, via any **TCP/IP network**) . . . **both the video and audio** portions of the presentation may be provided solely by a **TCP/IP network** such as the Internet." *Id.*, 2:1-10.

1[A][2]: "wherein at least two different copies of the digital content are each encoded at different bit rates and stored on the at least one server,"

63. In my opinion, Ogdon in view of Allen teaches 1[A][2]. Ogdon describes at least two different copies (versions) of the digital content (audio and/or video) are and stored on the server because Ogdon explains that each video presentation has "[d]ifferent versions of the same presentation" with "different network requirements," for example, "a first version of a presentation may require a network transmission rate sufficient for real time or animated video" (EX1004, 2:30-66) and "**several variations** of presentation content can be provided to clients based on the available bandwidth" (*id.*, 13:47-49). Ogdon further explains that alternative versions include "**limited** [] animation" and "**full** animation" digital content.

EX1004, 22:42-47. Ogdon describes that these "[d]ifferent versions of the same presentation" digital content are stored and "accessible from the one or more of the content webservers." EX1004, 2:30-31, 9:30-31, 22:60-64; *see also id.*, 9:44-46 ("content manager 104 distributes presentation content (e.g., presentation segments) to the content webservers 96"); claim 21 ("storing a plurality of segments of a presentation for network access via one or more content supply nodes"), FIG. 2C (step 508 "list of network 70 addresses (URLs) of the content webserver(s) 96 from which this next collection of segments can be retrieved").

64. Ogdon further teaches that the different versions (*e.g.*, limited animation content and full animation content) are each encoded at different bit rates from the same underlying original copy. For example, Ogdon explains that "said first subcollection includes a first video portion, and said second subcollection includes a different second video portion that **corresponds in content with** said first video portion, and wherein said first and second video portions have substantially different expected data transmission rates for being transmitted to said first client node" (EX1004, claim 9), and that these "several variations of presentation content can be provided to clients based on the available bandwidth" (*id.*, 13:47-49) wherein a version of "**greater size** (and corresponding **enhanced quality** of presentation) can be retrieved" (*id.*, Abstract) and "alternative segment collections [that] are

smaller" in size can alternatively be retrieved (*id.*, 24:55). A POSITA would have understood these disclosures in Ogdon to teach encoding a higher quality version of from a source (such as a "full animation" version with a higher size, higher bitrate, and higher transmission rate requirement) and encoding a smaller-sized alternative lower quality version from the same source (such as a "limited animation" version with a smaller size, lower bitrate, and lower transmission requirement). A POSITA would not have understood these disclosures to describe creating from scratch each "version" of digital content because each version "corresponds in content" and it was well-known to use encoding schemes to encode digital content, such as video, from a common source to generate different quality levels having different bitrates (and thus having different network transmission requirements).

65. Further, it was well-known to a POSITA at the time of the alleged Priority Date to provide three or more alternatives of media at different bitrates (quality levels). *See, e.g.*, EX1007, 9:14-22 (three alternative files), 10:15-24 (four alternative video files encoded at four different bitrates requested by the client based on client-determined bandwidth).

66. A POSITA would have understood Ogdon's disclosure of different versions of the same video presentation each having "different network requirements" to disclose digitally encoding the same raw uncompressed video

content into two or more (*e.g.*, three) versions having different bitrates. It was well-known to a POSITA at the time of the alleged Priority Date that streaming different versions of content at different quality levels depending on client network requirements meant encoding the content into different quality levels with different bitrates. For example, a POSITA understood that if a higher quality and a lower quality of the same video were provided, the lower quality version had "fewer bits per frame and provides a video image much more quickly than" a higher quality version "with a higher number of bits and hence higher quality video image." EX1023, Abstract, *see also id.*, 3:29-35 ("a server provides at least two different data streams. . . . a low resolution stream encoded at a bit rate below the transmission bit rate. . . . a normal resolution stream encoded at a bit rate equal to the transmission bit rate."), 10:16-21 ("quality (also referred to as resolution) is a measure of detail in an image . . . quality of an image is commonly measured in pixels per inch and in the number of bytes used to described the color values at each pixel"), 11:6-7 ("low bit rate encoding for the same content").

67. To the extent it is argued that Ogdon does not explicitly teach encoding the different versions of digital content into different bitrates as claimed, Allen teaches this limitation and a POSITA would have been motivated to combine Ogdon with Allen to arrive at this limitation. Allen teaches that it was known to encode

digital content (from the same underlying source) into at least three different quality levels (or bitrates) for streaming in order to allow streaming to various clients with different network requirements including, for example, encoding video at 56 kbps, at 300 kbps, and at 600 kbps. EX1005, 12:1-5. A POSITA would have been motivated to encode the same source video and/or audio digital content presentation of Ogdon, including each sequential segment, into each of at least two different (*e.g.*, high, medium, and low) quality level bitrate streams, as taught by Allen, because providing three different quality levels (low at 56 kbps, medium at 300 kbps, and high at 600 kbps) would enable user client nodes with a wide variety of network bandwidth requirements to stream the video presentation—a stated goal of Ogdon. EX1004, Abstract ("client network nodes with varying available network bandwidths can be utilized for synchronously and simultaneously performing the presentation"). A POSITA would have had a reasonable expectation of success with such a combination because both Ogdon and Allen are drawn to similar systems of client-server based streaming and because simply encoding into different versions (quality levels) at different bitrates to generate different versions of the same content with different transmission requirements would have been a simple and straightforward modification for a POSITA.

1[A][3]: "wherein each copy of the digital content is divided into a plurality of streamlets, each of the plurality of streamlets of a corresponding copy comprising a different portion of the digital content during presentation,"

68. In my opinion, Ogdon in view of Allen teaches 1[A][3]. *See* 1[A][2]. Ogdon describes that each copy (version) of the digital content is made up of set(s) of "streamlets" ("segments") and each segment has alternative bitrate versions for the client nodes to choose from. Ogdon uses the term "segment" to mean a portion of the video presentation and explains that "one or more" segments may be grouped into an "element," "collection," or "subcollection." *E.g.*, EX1004, 2:36-49, 4:29-36, 18:40-45, 22:10-29. Ogdon explains that this is "an indivisible portion" of the video presentation. EX1004, 2:36-42. The entire presentation is therefore a set of streamlets (segments). *Id.* Ogdon's streamlets (segments) each yield a different portion of the video on playback because, the "**subcollection of segments (i.e. presentation elements)** [are] ordered according to their presentation sequence." EX1004, 2:44-45, 3:46-47 ("presentation as an **ordered series of presentation segments**"), claim 21 ("there are subcollections of one or more segments, each subcollection having a predetermined presentation order"), FIG. 2C (step 508 "next collection of one or more (video) segments").

1[A][4]: "wherein corresponding streamlets across the at least two different copies comprise the same corresponding portions of the digital content during presentation,"

69. In my opinion, Ogdon in view of Allen teaches 1[A][4]. *See* 1[A][2] (Allen teaching encoding at different bitrates from same source). Ogdon's corresponding streamlets (segments) across the at least two different copies (versions) comprise the same corresponding portions of the digital content during presentation because each version (*e.g.*, high quality (full animation) and lower quality (limited animation) versions) of the stream encodes the same portion of the presentation at different quality levels. EX1004, 2:43-49 ("each version of a presentation typically has its subcollection of segments (i.e. presentation elements) ordered according to their presentation sequence" and "**every segment** (or subcollections thereof) in one version corresponds with a segment (or subcollections thereof) **having the same presentation order in each of the other versions**."); *see also id.*, 2:49-55 ("**corresponding segments** (or subcollections thereof) in different versions" are the same such that "any of the corresponding alternative segments (or subcollections thereof) from different versions can be **presented as a replacement for another such corresponding segment** (or subcollection) during the presentation."), claim 21 ("said first subcollection is **replaceable** with said second subcollection").

1[A][5]: "and wherein the client module streams the digital content by:"

70. In my opinion, Ogdon teaches 1[A][5]. Ogdon describes that the client module (software 88 and/or browser) streams the digital content because Ogdon describes requesting, receiving, and playing back the content as it is received. *See* 1[Pre], 1[A][1]; 7:52-63 ("if the client node 56 is resident at a client site 54, then a network interface software package is required for receiving, e.g., video presentation information from the communications network 70 . . . includ[ing] a network browser 78 such as the Internet browsers offered by Microsoft and Netscape, together with a client presentation software system 88 that coordinates with the browser 78 **for requesting, receiving and displaying presentation segments (from the network 70) as appropriate during the presentation**.").

1[B]: "requesting a first streamlet from the at least one server;"

71. In my opinion, Ogdon teaches 1[B]. Ogdon describes that the software/browser requests a first streamlet (initial segments) from a webserver. EX1004, 19:54-58 ("client presentation software 88 . . . retrieve[s] and cache[s], via network 70, **one or more initial presentation segments** from identified **content webservers 96**"), 7:52-63, , 2:39-40, 22:30-33.

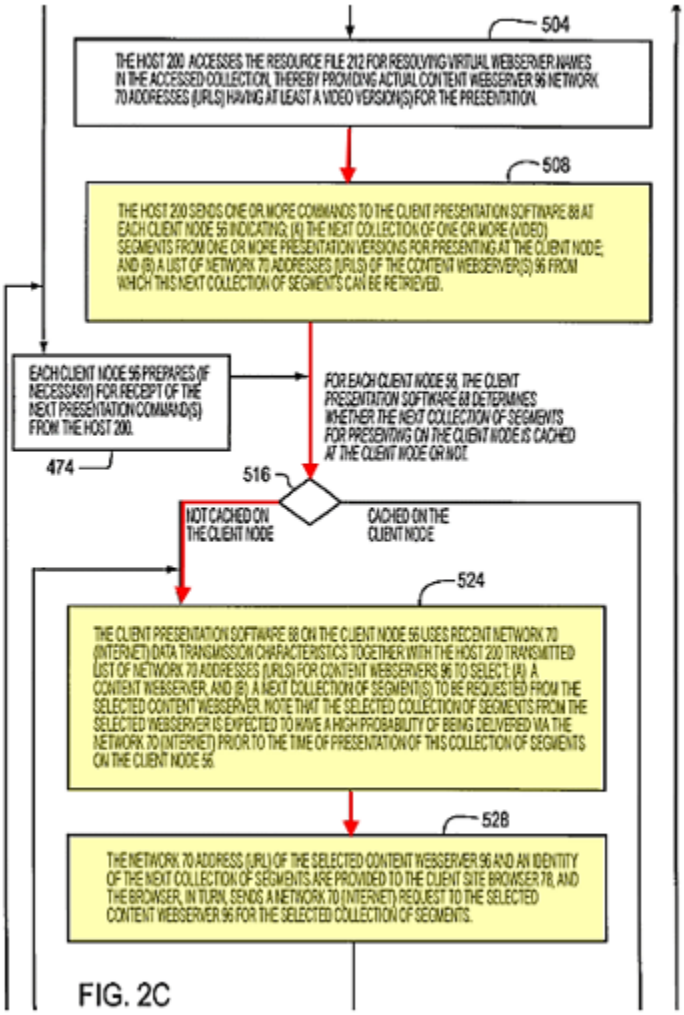
1[C][1]: "automatically requesting from the at least one server subsequent portions of the digital content by requesting for each subsequent portion of the streamlets from the different copies of the digital content dependent upon successive determinations by the client module to change a currently requested bit rate to a higher or lower bit rate, the automatically requesting including"

72. In my opinion, Ogdon teaches 1[C][1]. Ogdon describes automatically requesting from the at least one sever (webservers 96) subsequent portions of the digital content. EX1004, FIG. 2 (showing loop back such that each client node automatically requests appropriate quality level at appropriate network address of next collection of segments once provided by the host (*e.g.*, step 508 and 516)), 6:18-23 ("Thus, when the data required for a segment is not timely cached prior to its intended performance at a client's node, alternate segment data is **automatically requested** from the communications network by the client node."), FIG. 2C (step 524: "The client presentation software 88 . . . select[s] . . . **a next collection of segment(s)**"). Ogdon describes that selection of a higher or lower quality bitrate for each segment may be based upon successive determinations (*e.g.*, (step 516) client **determines** whether segments are already cached; (step 532) after requesting, client **determines** whether the requested segments are cached within a desired time; (step 536) if no, client **determines** whether there is time to try again; (step 544) if yes, client **determines** network characteristics at client node). *Id.*, FIGs. 2C-2D, 24:50-

57 ("on such **subsequent iterations for determining** an alternative way to present a particular portion of the presentation, the following steps may be performed: the **original calculation is again performed with new times and current bandwidth information** . . . [a]n overall limit of three re-tries of any URL will force smaller alternative segment collections to be selected"), claims 3 ("without manual input from the first user"), 11 ("without user selection input").

73. Ogdon further discloses making such successive determinations to shift the playback quality to a higher or lower quality one of the different copies of the video because Ogdon repeatedly determines, based on bandwidth, in a loop to shift the quality of the segments.

74. "[I]f the next collection of segments is not cached on a client node 56, then step 524 is performed wherein the client presentation software 88 on the client node 56 uses its most recent network 70 data transmission characteristics together with the host 200 transmitted list of current network 70 addresses for content webservers 96 **to select** an appropriate content webserver and **an appropriate version of the next collection of segments to be retrieved**." *Id.*, 22:10-18, 23:5-22 (calculating bandwidth to "[s]elect the highest quality collection of presentation elements available"), 23:40-48, 24:50-57; *see also* EX1004, FIGs. 2B-2D.



EX1004, FIG. 2C (annotated).

1[C][2]: "repeatedly generating a factor indicative of a current ability to receive digital content at a rate sufficient for presenting the digital content as the digital content is received;"

75. In my opinion, Ogdon teaches 1[C][2]. Patent Owner contended in the file history of parent U.S. Patent No. 8,868,772 that there is allegedly sufficient disclosure for such a factor being "indicative of latency, delays or losses of the

requested portions, and available bandwidth of the TCP connections." EX1018, 447-448 (footnotes omitted).

76. Ogdon describes generating factors "indicative of the current ability to sustain the streaming of the digital content using the files from different ones of the copies" by repeatedly calculating data transmission characteristics such as the current client node bandwidth to select a quality version for each segment collection and thus repeatedly generating a factor indicative of a current ability to receive digital content at a rate sufficient for presenting the digital content as the digital content is received. EX1004, 22:10-23 ("the client node 56 uses its **most recent network 70 data transmission characteristics** together with the host 200 transmitted list of current network 70 addresses for content webservers 96 **to select** an appropriate content webserver and **an appropriate version of the next collection of segments to be retrieved**."), 23:5-22 (calculating "average bandwidth" for "[s]elect[ing] the highest quality collection of presentation elements available"), FIG. 2C ("Client node 56 uses recent network 70 (Internet) data transmission characteristics . . . to select . . . (B) a next collection of segment(s) to be requested from the selected content webserver."), 5:36-39 ("several variations of presentation content can be delivered **based on, e.g., the current bandwidth available** and the client's affiliated network server(s)."), 13:47-49, 24:50-57 ("on such subsequent

iterations for determining an alternative way to present a particular portion of the presentation, the following steps may be performed: the original calculation is again performed with new times and current bandwidth information . . . [a]n overall limit of three re-tries of any URL will force smaller alternative segment collections to be selected"), claim 2; 1[C][1].

1[D]: "making the successive determinations to change the digital content bit rate based on the factor using the streamlets of one of the different copies of the digital content having the highest bit rate determined receivable for presentation so that the client module selects a higher bit rate one of the different copies when the factor is greater than a first threshold and selects a lower bit rate one of the different copies when the factor is less than a second threshold; and"

77. In my opinion, Ogdon teaches 1[D]. As explained above, Ogdon describes making successive determinations to change the digital content bit rate of requested sequential sub-files based on the factor (*e.g.*, "measured rate"). *See* 1[C][1]-1[C][2]. Ogdon describes making the successive determinations to change the digital content bit rate based on the factor using the streamlets (segments) of one of the different copies of the digital content having the highest bit rate determined receivable for presentation. In Ogdon, the process for retrieving the next file and determining whether to shift the playback quality of the next file to the highest quality receivable is carried out in a loop. *See* EX1004, 23:10-23, FIG. 2B (step 476

"first (next) collection of corresponding presentation segments"), FIG. 2C (step 508 "next collection of one or more (video) segments from one or more presentation versions" and steps 524, 528), FIG. 2D (step 552 present "the next segment" and loop at 560), 22:10-18, 23:5-22 (calculating bandwidth to "[s]elect the highest quality collection of presentation elements available"), 23:40-48, 24:50-57.

78. Ogdon teaches upshifting to a higher quality one of the different copies (*e.g.*, higher quality full animation version) when a certain threshold is exceeded such that the factor is greater than a first threshold (*e.g.*, bandwidth high enough to timely cache higher quality) and similarly downshifts to a lower quality one of the different copies (*e.g.*, lower quality reduced animation version) when the factor is less than a second threshold (*e.g.*, bandwidth only sufficient to timely cache lower quality), *i.e.*, determining whether the higher quality playback can be sustained. *See* EX1004, 6:14-23 ("the present invention monitors: . . . the data transmission rate . . . the amount of data cached on each client's node" and "when the data required for a segment is not timely cached prior to its intended performance at a client's node, alternative segment data is automatically requested"), FIG. 2C (step 524 selecting segments that "have a high probability" of being delivered "prior to the time of presentation"), 2:62-66, 21:61-62.

1[E]: "arranging the streamlets requested from the at least one server in order of ascending presentation time for output to a presentation device."

79. In my opinion, Ogdon teaches 1[E]. Ogdon describes arranging the streamlets (segments) requested from the at least one servers in order of ascending presentation time. *See* 1[Pre]; 1[B]; EX1004,7:59-63 ("a client presentation software system 88 that coordinates with the browser 78 for requesting, receiving and displaying presentation segments (from the network 70) as appropriate during the presentation"), 26:37-39 ("provide a particular presentation content file (e.g., of presentation elements) at a client node 56 in time for display."), 2:44-45, 3:46-47 ("presentation as an **ordered series of presentation segments**"), claim 21 ("there are subcollections of one or more segments, each subcollection having a **predetermined presentation order**"), FIG. 2C (step 508 "next collection of one or more (video) segments").

Claim 2: "The end user station of claim 1, wherein at least some streamlets are requested from the at least one server via a hypertext transfer protocol (HTTP) GET request."

80. In my opinion, Ogdon in view of Allen teaches claim 2. As explained above, Ogdon describes that the end user station requests streamlets from a conventional webserver via HTTP. *See* 1[A][1], 1[B], 1[C][1]. Ogdon describes that "the presentation element(s) selected is dependent upon network protocols such as

HTTP" noting that "as the size of the presentation data and the time for retrieval decreases, the present invention tends to use HTTP" and, for example, "there is a primary webserver 96a and an alternative webserver 96b, and each has presentation versions for both HTTP and FTP as well as both having animated and non-animated interchangeable presentation elements." EX1004, 22:48-64.

81. A POSITA would have understood Ogdon's descriptions of client end user stations making HTTP requests for subfiles from ordinary webservers to include disclosure of HTTP GET requests for said subfiles because a POSITA would have known that HTTP/1.1 required servers to implement the GET method and that "GET is the most common method" in HTTP and "usually is used to ask a server to send a resource". EX1012, at 73-74; EX1019, 31 ("The methods GET and HEAD MUST be supported by all general-purpose servers"), 46 (HTTP 1.1 protocol describing "GET" as the means by which to "retrieve whatever information (in the form of an entity) is identified by the Request-URI"); EX1011. To the extent HTTP GET is not explicitly disclosed by Ogdon, a POSITA would have been motivated to use HTTP GET requests to request and receive sub-files from Ogdon's servers because HTTP GET requests are one of a finite number of identified methods available in the HTTP protocol, and thus one of a finite number of identified predictable solutions (indeed, the only solution) for requesting files from a server with a reasonable expectation of

success. EX1019, 45-47; EX1011. There also would have been a reasonable expectation of success because HTTP is a universally known and used protocol and GET requests are a standard method within that protocol for requesting files from a server.

Claim 3: "The end user station of claim 1 wherein the at least one server comprises at least two servers and wherein at least one streamlet is requested from a first of the at least one server and at least one other streamlet is requested from a second server of the at least one server other than the first server."

82. In my opinion, Ogdon in view of Allen teaches claim 3. *See* 1[A][2]. Ogdon discloses the at least one server comprises at least two servers (webservers 96a and 96b) and wherein at least one streamlet (segment) is requested from a first of the at least one server and at least one other streamlet is requested from a second server of the at least one server other than the first server because Ogdon describes "content webservers 96a, and alternate content webservers 96b" where "content webservers 96a" is the server of first choice but where a client "is capable of requesting, via the browser 78 at the client site, presentation segments from an alternate content webserver 96b." EX1005, 8:27-40, 9:44-46 ("distributes presentation content (e.g. presentation segments) to the content webservers 96"), 22:60-23:5 ("there is a primary webserver 96a and an alternative webserver 96b, and each has presentation versions for both HTTP and FTP as well as both having

animated and non-animated interchangeable presentation elements . . . the expected times are used to select the webservers 96, the collection of presentation elements, and the transfer protocol to use"), 24:17-49.

Claim 4: "The end user station of claim 1, wherein the client module repeatedly generates the factor based on a moving time window."

83. In my opinion, Ogdon in view of Allen teaches claim 4. As explained above, Ogdon describes that the client module repeatedly generates a factor based on a moving time window. *See* 1[C][2]; EX1004, 24:52-55 ("the original calculation is again performed with **new times and current bandwidth information**"), 23:24-28 ("additional network characteristics other than bandwidth may be used" such as "network 70 error rates, fluctuations in bandwidth, or a predictive statistical expectation of bandwidth may be used"), ("comparing elapsed time as in (7.2)").

Claim 5: "The end user station of claim 1, wherein the client module generates the factor based on a current read ahead margin."

84. Ogdon in view of Allen teaches claim 5. As explained above, Ogdon describes that the client module repeatedly generates factors including current bandwidth and other factors related to other "network characteristics." *See* 1[C][2], claim 4. Ogdon teaches generating these factors based on a current read ahead margin because, at step 516, the client presentation software determines whether the

next collection of segments is cached at the client node, *i.e.*, whether an amount of contiguously available, sequentially arranged requested files is received. If yes, then it proceeds (through step 548) to step 552 and presents the next segment, *i.e.*, according to there being a nonzero amount of such files. EX1004, FIG. 2C step 516, FIG. 2D step 552, 24:60-25:30 (if the requested collection of segments is cached, present all segments to the client); *see also id.*, 21:61-64 ("client nodes now enter a processing state whereby these nodes attempt to assure a timely caching of this next collection of segments for timely performance of their portion of the presentation"), 24:14-49 (if selected segments cannot be retrieved, determining if there is sufficient time to try again, *i.e.*, enough of the presentation buffered to try to download the same segments again); And at step 524, the client presentation software determines whether the selected collection of segments "is expected to have a high probability of being delivered . . . prior to the time of presentation.". EX1004, FIG. 2C step 524.

Claim 6: "The end user station of claim 1, wherein a first streamlet of each copy of the digital content has the same first duration and corresponds to a same first temporal portion of the digital content, wherein a second streamlet of each copy of the digital content have the same duration and correspond to a same second temporal position of the digital content."

85. In my opinion, Ogdon in view of Allen teaches claim 6. Ogdon describes that each streamlet (segment) across the different copies are the same

duration and contain the same portions of the digital content on playback because Ogdon describes "[d]ifferent versions of the same presentation" (EX1004, 2:30) and that each version has segments that "correspond[] with a segment . . . having the same presentation order, in each of the other versions" (*id.*, 2:47-49) such that the plurality of streamlets that collectively make up the entire video presentation stream for each version of the same video presentation would be equal to each other in duration. In other words, Ogdon describes that full digital presentation stream (made up of a plurality of segments) are the "same" at each quality level and thus each quality level stream have durations equal to each other. Additionally, Ogdon discloses that each individual corresponding segment in each version also have the same duration. EX1004, 2:49-55 ("corresponding segments (or subcollections thereof) in different versions have approximately the **same presentation duration**" so that "any of the corresponding **alternative segments (or subcollections thereof) from different versions** can be presented as a **replacement** for another such corresponding segment (or subcollection) during the presentation."), 2:43-49 ("each version of a presentation typically has its subcollection of segments (*i.e.* presentation elements) **ordered according to their presentation sequence**" and "every segment (or subcollections thereof) in one version **corresponds with a segment** (or

subcollections thereof) having the **same presentation order in each of the other versions**.").

86. Ogdon thus states that each corresponding segment at various versions should serve as "replacement" for one another and that the durations are "approximately the same presentation duration." A POSITA would have understood this teaching of "approximately the same" duration not to be limited to only durations that are close but not exactly the same, but rather encompassing durations that are either the same, or approximately the same—especially given additional evidence from Ogdon's provisional application and file history as discussed below. Thus, Ogdon discloses that each corresponding version of each segment is the same portion of the video and has the same duration because they are replacements for one another. A POSITA would have understood this disclosure to teach a same or equal duration in order to allow alternative versions of each segment to serve as a "replacement" for each other to provide seamless streaming for the user—especially in light of the combination with Allen which teaches encoding each version from the same underlying digital content source.

87. Additionally, the provisional application of Ogdon (U.S. 60/041,770) also teaches that "corresponding presentations segments in the collection have identical audio portions." EX1022, 35 (claim 25). A POSITA would have

understood this disclosure to teach that corresponding alternate video presentation segments can each have identical audio portions, which would mean that the alternate video presentation segments would also have identical (*i.e.,* same or equal) durations. And during prosecution of the Ogdon patent, the Applicant characterized the Ogdon invention as having different versions "with identical (and/or content corresponding) portions of the presentation." EX1021, 239. A POSITA would have considered this a further teaching of identical (*i.e.,* same or equal) time durations for each corresponding video segment version.

88. To the extent it is found that Ogdon does not disclose that the plurality of streamlets in each of the quality level streams have a duration that is the same as each other, a POSITA would have been motivated to make all of the corresponding segments in each version an equal duration of time to simplify the system and so that each corresponding streamlet in each version could serve as a replacement for that portion of presentation content so that when switching to a different version during the presentation the user still experiences a seamless presentation. Having corresponding streamlets across different versions be of different playback durations would complicate the presentation of video and may result in an undesirable viewing experience because it would prevent seamless streaming when switching quality levels if playback commences with the beginning of each version file. *Id*. A POSITA

would have had a reasonable expectation of success with such a modification because it would have been a straightforward and simple modification to make each segment an equal duration.

Claim 7: "The end user station of claim 6, wherein the first and second duration of the first streamlets of each copy are different from the durations of the second streamlets of each copy."

89. In my opinion, Ogdon in view of Allen teaches claim 7. A POSITA considering Ogdon would have been motivated to make the first and second durations (of the first and second segments, respectively) of each copy different. For example, a POSITA would have known that it was desirable to "reduce[] the start-up" for streaming content to beneficially allow the user to view the stream more quickly. EX1023, 3:29-54. Given this knowledge, a POSITA would have been motivated to make a first duration (*e.g.*, of the first segment of a stream) shorter than a second duration (*e.g.*, of the second segment of a stream) because a shorter first segment when requested by the client (*e.g.*, at a low quality) can be more quickly downloaded and played back for the user while the client makes a determination of an appropriate quality level to select for the second streamlet based on a bandwidth determination from receiving the first segment. *Id.* In this way, the playback is started after only a short time and quickly adjusted to the most appropriate bandwidth version being played back for the user soon after the streaming begins.

90. Alternatively, it would have been "obvious to try" for a POSITA to make the first and second durations (of the first and second segments, respectively) different rather than the same because this would be a POSITA choosing between one of a finite number of possible solutions. Namely, a POSITA would have only two possible solutions for choosing segment durations: (1) all segments (including the first and second segments) have the same duration, or (2) some segments (*e.g.*, the first and second segments) each have different durations. *Id*. Therefore, it would have been obvious for a POSITA to try making the durations different as one of a finite number of solutions. *Id*. A POSITA would have had a reasonable expectation of success with such modifications because the segments all have *some* duration and merely adjusting the duration of each segment so that the first segment duration is different from the second segment duration would have been a simple and straightforward modification for a POSITA.

Claim 8: "The end user station of claim 6, wherein each of the first streamlets has a first duration that is a range of 0.1 to 5 seconds."

91. In my opinion, Ogdon in view of Allen teaches claim 8. A POSITA considering Ogdon would have been motivated to make the first durations (of each of the first segments) in the range of 0.1 to 5 seconds. For example, a POSITA would have been motivated to make the first duration (of each of the first segments) 1

second or 2 seconds because this would minimize download time and allow playback to begin quickly while also allowing the client to make a bandwidth determination and provide sufficient time for the client to request further sequential segments to queue for playback. *Id*. Additionally, it would have been "obvious to try" for a POSITA to make the first duration (of the first segment) in the range of 0.1 to 5 seconds because this would be a POSITA choosing between one of a finite number of possible solutions. *Id*. Namely, a POSITA would have to assign some duration to the first segment such that the segments are sufficiently long to allow for quick playback but sufficiently short in duration to allow for rapid switching to different quality levels as necessary—this duration would have to be on the order of single digit seconds (*e.g.*, 1-5 seconds), double digit seconds, or minutes. *Id*. Therefore, it would have been obvious for a POSITA to try making the duration of the first segment between 0.1 to 5 seconds) as a finite number of possible solutions. *Id*. A POSITA would have had a reasonable expectation of success with such modifications because the segments all have *some* duration and merely adjusting the duration the first segment so that the first segment duration between 0.1 to 5 seconds in duration would have been a simple and straightforward modification for a POSITA.

Claim 10: "The end user station of claim 1, wherein the client module is further configured to output the streamlets requested from the at least one server to the presentation device in the order of ascending presentation time."

92. In my opinion, Ogdon in view of Allen teaches claim 10. Ogdon describes that that the client module is configured to output the streamlets (segments) requested from the at least one server to the presentation device in the order of ascending presentation time. *See* 1[E].

Claim 11: "The end user station of claim 1, further comprising the presentation device to display the streamlets in the order of ascending presentation time."

93. In my opinion, Ogdon in view of Allen teaches claim 11. *See* 1[E], claim 10.

Claim 12:

12[Pre]: "A method executable by a client device to output rate-adaptive streams received via at least one transmission control protocol (RCP) [sic] connection with at least one server over a network, the method comprising:"

94. In my opinion, whether or not the preamble is limiting, Ogdon teaches 12[Pre]. *See* 1[Pre], 1[A][1].

12[A][1]: "receiving, by the client device, digital content from the at least one server via the at least one TCP connection over the network,"

95. In my opinion, Ogdon teaches 12[A][1]. *See* 1[A][1].

12[A][2]: "wherein multiple different copies of the digital content encoded at different bit rates are stored as individually-requestable portions on the at least one server,"

96. In my opinion, Ogdon in view of Allen teaches 12[A][2]. *See* 1[A][2], 1[A][3], 1[B], 1[C][1]. Ogdon's segments are each "individually-requestable portions" because they are requested individually sequentially. *Id.*

12[A][3]: "wherein each of the individually-requestable portions of a corresponding copy of the digital content is a different portion of the digital content during presentation,"

97. In my opinion, Ogdon in view of Allen teaches 12[A][3]. *See* 1[A][3].

12[A][4]: "wherein the individually requestable portions across the different copies yield the same portions of the digital content upon presentation, and wherein the receiving comprises:"

98. In my opinion, Ogdon in view of Allen teaches 12[A][4]. *See* 1[A][4].

12[B]: "requesting by the client device a plurality of sequential individually-requestable portions of one of the copies from the at least one server;"

99. In my opinion, Ogdon in view of Allen teaches 12[B]. Ogdon discloses requesting a plurality of individually-requestable portions (*i.e.*, initial segments) of one of the one of the copies from at least one server. *See* 1[B] (requesting initial segments).

12[C][1]: "automatically requesting by the client device from the at least one server subsequent portions of the digital content by requesting for each such portion one of the

individually-requestable portions from one of the copies dependent upon successive determinations by the client device to change a requested bit rate to a higher or lower bit rate one of the different copies, the automatically requesting including"

100. In my opinion, Ogdon teaches 12[C][1]. *See* 1[C][1].

12[C][2]: "repeatedly generating a factor indicative of a current ability to receive the digital content at a rate sufficient for presenting the digital content as the digital content is received, individually-requestable wherein the factor relates to a performance of the network; and"

101. In my opinion, Ogdon teaches 12[C][1]. *See* 1[C][1].

12[D]: "making the successive determinations whether to change the requested bit rate based on the factor to achieve continuous presentation of the digital content using the individually-requestable portions of the highest bit rate one of the copies determined receivable at that time at a rate sufficient for presenting the digital content as the individually-requestable portions of the digital content are received, wherein the making of the successive determinations to change the requested bit rate comprises: requesting a subsequent individually-requestable portion from a higher bit rate one of the different copies than a currently requested one of the different copies when the at least one factor is greater than a first threshold; and requesting a subsequent individually-requestable portion from a lower bit rate one of the different copies than the currently requested one of the different copies when the at least one factor is less than a second threshold; and"

102. In my opinion, Ogdon teaches 12[D]. *See* 1[D].

12[E]: "arranging the individually-requestable portions requested from the at least one server in order of ascending presentation time for output to a presentation device."

103. In my opinion, Ogdon teaches 12[E]. *See* 1[E].

Claim 13: "The method of claim 12 wherein the automatically requesting comprises requesting at least some individually requestable portions via a hypertext transfer protocol (HTTP) GET request."

104. In my opinion, Ogdon in view of Allen teaches claim 13. *See* claim 2.

Claim 14: "The method of claim 12 wherein the at least one server comprises at least two servers and wherein the client device requests at least one streamlet from a first server of the at least two servers and at least one other streamlet from a second server of the at least two servers other than the first server."

105. In my opinion, Ogdon in view of Allen teaches claim 14. *See* claim 3.

Claim 15: "The method of claim 12, wherein the digital content is stored on the at least one server in a plurality of streamlets, each of the plurality of streamlets corresponding to a different temporal portion of said digital content and wherein each of the individually-requestable portions is requestable by the client device without regard to whether the client device has previously requested other individually requestable portions of the digital content."

106. In my opinion, Ogdon in view of Allen teaches claim 15. *See* 12[A][2], 1[B], 1[C][1].

Claim 17: "The method of claim 12, wherein the making the successive determinations to change the requested bit rate comprises: determining if the higher bit rate one of the different copies can be received at a rate sufficient for presenting the digital content as the digital content is received."

107. In my opinion, Ogdon in view of Allen teaches claim 17. *See* 1[D].

Claim 18: "The method of claim 12, wherein the factor is indicative of a delay or a loss in one or more of the at least one TCP connections."

108. In my opinion, Ogdon in view of Allen teaches claim 18. Ogdon describes generating a factor (network transmission characteristics) that is indicative of delays or losses in a TCP connections. *See* 1[C][2]; EX1004, 6:9-26 ("there is still the possibility of **data delays** from a slow network server"; "Accordingly, the present invention monitors: (a) characteristics of network transmissions of presentation materials to client nodes . . . ."; considering whether "the data required for a segment is **not timely cached** prior to its intended performance at a client's node"), 23:24-28 ("additional network characteristics other than bandwidth may be used" such as "network 70 error rates"), 23:40-24:27 ("[T]he client presentation software 88 monitors the time elapsed before transmission of the selected collection of segments is completed, and determines whether these segments are provided within **an appropriate window of time** that allows them to be presented during performance of the presentation."; "[F]or determining this desired time, a function

dependent on one or more of: (a) various measurements related to one or more other client nodes 56 receiving the presentation performance, (b) a predetermined default length of time, as e.g., specified in the presentation script, and (c) a length of time determined by a leader of the presentation performance, e.g., during the performance."; measuring "network 70 transmission rates for each one or more previous requests for presentation segments"; "the client presentation software 88 determines if there is sufficient time to retry obtaining the collection of segments or another collection of alternative segments prior to the time of their estimated performance").

Claim 19: "The method of claim 12, wherein the at least one server comprises a cache server of a network infrastructure operator."

109. In my opinion, Ogdon in view of Allen teaches claim 19. Patent Owner admits that "[u]se of cache servers is well known to those skilled in the art, and will not be discussed further herein." EX1001, 9:52-54. Further, such cache servers, also referred to as "web caches," were well-known before the alleged Priority Date. For example, it was well-known that cache servers were used to store copies of popular files and were beneficial to client-server systems because cache servers reduce redundant data transfers, reduce network bottlenecks, reduce the load on origin servers, and reduce distance delays. EX1012, 181-186. A POSITA would have been

motivated to configure Ogdon's apparatus to connect to a cache server in order to improve and increase reliability of response time and performance as compared to connecting to an origin webserver and reduce the load on the origin server. A POSITA would have had a reasonable expectation of success with such a modification because the cache servers were well known, as admitted by Patent Owner, and implemented by ISPs and other network infrastructure operators in common networking protocols as alternatives to webservers.

Claim 20: "The method of claim 12, further comprising: outputting the received content to the presentation device."

110. In my opinion, Ogdon in view of Allen teaches claim 20. *See* 1[E].

H. Claim 9 Would Have Been Obvious in view of Ogdon, Allen, and Klements

111. As explained above, it is my opinion that Ogdon in view of Allen teaches claims 1-8, 10-15, and 17-20. I incorporate my opinions in Section VII.G into this section by reference. To the extent it is argued that Ogdon in view of Allen fails to teach certain limitations, Ogdon in view of Allen and Klements teaches these limitations.

Claim 9: "The end user station of claim 1, wherein the client module is further configured to transmit at least one virtual timeline request to retrieve a virtual timeline corresponding to the digital content and to receive the virtual timeline from the at least one server; and arrange the streamlets requested from the at least one server using the virtual timeline."

112. As explained above, it is my opinion Ogdon in view of Allen teaches claim 1. Further, in my opinion Ogdon describes that the host 200 ensures the sequential playback of the streams at appropriate resolutions by sending one or more commands (which may be considered virtual timelines in the form of a playlist) to the client indicating the next ordered collection of segments for the client to request from the servers at resolutions appropriate for the client based upon its network bandwidth. EX1004, FIG. 2C (step 508 "The host 200 sends one or more commands to the client presentation software 88 at each client node 56 indicating: (A) the next collection of one or more (video) segments from one or more presentation versions for presenting at the client node and (B) a list of network 70 addresses (URLs) of the content webserver(s) 96 from which this next collection of segments can be retrieved"), 3:24-63 (host transmit "presentation controlling commands to the client nodes so that there is retrieval of the presentation segments from one or more versions of the one or more network content server nodes depending on, for example,

performance characteristics of network transmissions" and clients receive "the ordered segments" requested and obtained from the webserver(s)).

113. Ogdon further describes such commands as a virtual timeline (playlist) because the "host 200 designates time according to at least one of the following categories: . . . a specific time interval indicated in a script command for the presentation, *e.g.*, a 'virtual time' command as indicated by commands (rows) of the script shown in FIG. 3." EX1004, 22:10-47, FIG. 3, 25:63-26:14. Ogdon further explains that a virtual playlist (script) schedules sequential full presentations with scheduled show times because Ogdon discloses that a host "receives content webserver 96 identifications, and presentation script identifications from a show scheduler 204" which "provides the functionality of the present information for scheduling presentation performance times" and "the show scheduler 204 provides the pre-show control 136 with scheduled show times and dates." EX1004, 12:9-19; 25:43-44 ("a single script may be used for a plurality of related presentations").

114. To the extent Ogdon is silent to the client module being configured to transmit a request for the virtual timeline from the at least one server and arrange the streamlets requested from the at least one server using the virtual timeline, Klements teaches this limitation. For example, Klements teaches generating a playlist of entire content files that are requested by a client module (media player) from the server,

for example, Klements teaches "twenty . . . songs to be part of a play list, and subsequently have those songs played back . . . by **selecting the playlist** . . . by selecting playback of the play list." EX1005, ¶ [0041]; *see also id.*, ¶ [0068] ("**streaming media player 142 indicates** to streaming module 144 that the player is ready for the next piece of content in the play list. . . . by communicating a 'stream next entry' command to streaming module 144"). Additionally, a POSITA would have been motivated to store a playlist on a server such that it is beneficially requestable by a client in order to permit many clients to have the ability to request and receive the same playlist and stream to play back the same content files in the same order. A POSITA would have had a reasonable expectation of success with such a modification because storing files on a server for client download was well-known.

115. A POSITA would also have been motivated to create a virtual timeline playlist corresponding to digital content of entire content files that a client module may request from a server; and arrange the streamlets requested from the at least one server using the virtual timeline that play one after the other, as taught by Klements, in order to set out a schedule of similar recordings for clients to play sequentially in succession so that the presentation is made in the order as originally intended instead of a random or different order. A POSITA would have had a reasonable expectation

of success with such a combination because both Ogdon and Klements are drawn to similar systems of client-server based streaming and generating such a playlist of entire content files would have been a straightforward modification for a POSITA.

I. Claim 16 Would Have Been Obvious in view of Ogdon, Allen, and Gamble

116. As explained above, it is my opinion that Ogdon in view of Allen teaches claims 1-8, 10-15, and 17-20. I incorporate my opinions in Section VII.G into this section by reference.

> **Claim 16: "The method of claim 12, wherein the at least one TCP connection comprises a plurality of different TCP connections, and wherein the requesting of the plurality of sequential individually-requestable portions includes requesting sub-parts of the individually-requestable portions over different ones of the plurality of different TCP connections, and wherein the arranging includes reassembling the individually-requestable portions from the requested sub-parts."**

117. In my opinion, Ogdon and Allen in view of Gamble teaches claim 16. Gamble teaches sub-parts of a plurality of files that are requested over a plurality of TCP connections and reassembled. For example, Gamble discloses a network application 112 operating on a client 106 that creates a receive buffer 706 to store a plurality of N segments (here, N=4) from stream files 706_1 through 706_4 received over N parallel connections from server 108. EX1020, ¶¶ 50-51. The receive buffer 706 includes multiple sub-buffers B1 through B4 to store N(=4) segments of a data

file 702A that are respectively streamed out of stream files 706_1 through 706_4. *Id.* ¶ 51. The segments in the receive buffer 706 are ordered into a data file 702B to match the order in data file 702A, and the process continues until all segments have been received and ordered. *Id.*, ¶ 52; *see also* ¶ 40. Gamble explains that the TCP layer 312 of the network connection operating on the client 106 acknowledges and reorders packets and can send packets on multiple or parallel connections. *Id.*, ¶ 37.

118. Additionally, a POSITA would have known that, using HTTP, a client could request sub-parts of a file by making RANGE requests. For example, a POSITA would have known that HTTP allows clients to request a byte range from a file and that requests could be made for multiple ranges from the same file in any order such that "client could connect to multiple servers simultaneously [and] request[] multiple ranges." EX1012, 383-384; EX1019, 119-121 (explaining HTTP RANGE requests, including requests for a single range or a set of ranges).

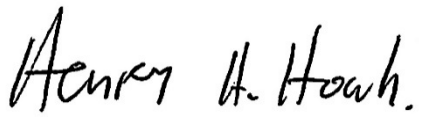
119. A POSITA would have been motivated to configure Ogdon to request sub-parts of the files (streamlets) over different TCP connections and reassemble the files from the received subparts, such as taught by Gamble. A POSITA would have understood that this improves reliability in situations where one connection fails by retrieving other subparts over other connections and retrieving more file data more quickly. A POSITA also would have understood that it takes advantage of available

bandwidth by parallelizing retrieval of a segment to increase throughput where an individual TCP connection's maximum throughput is the bottleneck. EX1012, 108-109 (explaining that parallel TCP connections were known and may be faster). A POSITA would have had a reasonable expectation of success with such a modification because the TCP protocol allows for multiple connections, and utilizing multiple connections to request and retrieve different parts of a single file was well known, as exemplified by Gamble.

IX. CONCLUSION

120. In my opinion, and for the reasons provided above, the Challenged Claims are obvious over at least Ogdon in view of Allen or Ogdon in view of Allen and Klements or Ogdon in view of Allen and Gamble combinations.

121. I declare that all statements made in this declaration regarding my personal knowledge are true and accurate, and that all statements made on information and belief are believed to be true. Further, I understand that these statements were made with the knowledge that willful false statements and the like are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the United States Code.



Henry Houh

Executed on May 21, 2024

Exhibit A

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Education

Massachusetts Institute of Technology, Cambridge, MA

- PhD in Electrical Engineering and Computer Science, February 1998. "Designing Networks for Tomorrow's Traffic," thesis supervised by Professor David Tennenhouse and Professor John Guttag. GPA 4.7/5.0
- Master of Science in Electrical Engineering and Computer Science, February 1991. "Demonstration of a laser repetition rate multiplier," thesis. GPA 4.5/5.0
- Bachelor of Science in Electrical Engineering and Computer Science, June 1989. "Boundary element analysis of arbitrarily shaped dielectric structures," thesis. GPA 4.7/5.0
- Bachelor of Science in Physics, February 1990. GPA 4.7/5.0

MITx, Cambridge, MA

- September 2020 – present: Enrolled in Statistics and Data Science MicroMasters program, a sequence of five MIT-offered graduate-level courses in statistics and machine learning, culminating in a MicroMasters certificate. Have completed four of five required courses.

Experience

Houh Consulting Inc. / Independent Consultant

- 2009 - present: Technical consultant specializing in Social Networking, Web 2.0, Web Site Development, Data Networking, Optical Networking, Telecommunications, Media Streaming and Voice Over IP. Clients include: Akin Gump Strauss Hauer & Feld LLP, Arnold & Porter Kaye Scholer LLP, BBN, Baker Botts LLP, Barnes & Thornburg LLP, BBN Technologies, Beus Gilbert McGroder PLLC, Bracewell LLP, Christensen O'Connor Johnson Kindness PLLC, Cooley LLP, Covington & Burling LLP, Cozen O'Connor P.C., DLA Piper, Davis Polk & Wardwell LLP, Desmarais LLP, Duane Morris LLP, Erise IP, P.A., Faegre Baker Daniels LLP, Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, Fish & Richardson P.C., Goldman Ismail Tomaselli Brennan & Baum LLP, Haynes and Boone, LLP, Kaye Scholer, Kellogg Huber Hanson Todd Evans & Figel PLLC, Kirkland & Ellis LLP, Klarquist Sparkman, LLP, McCarthy Tetrault LLP, McGuireWoods LLP, Morgan, Lewis & Bockius LLP, Munger Tolles & Olson LLP, Orrick, Herrington & Sutfliffe LLP, O'Melveny & Myers LLP, Orrick, Herrington & Sutcliffe LLP, Paul Hastings LLP, Paul, Weiss, Rifkind, Wharton & Garrison LLP, Perkins Coie LLP, Quinn Emanuel Urquhart & Sullivan, LLP, Sidley Austin LLP, Smith Baluch LLP, Sterne, Kessler, Goldstein & Fox PLLC, Troutman Sanders LLP, Venable LLP, Weil, Gotshal &

Manges LLP, Wiley Rein LLP, Wilmer Cutler Pickering Hale and Dorr LLP, and Winston & Strawn LLP.

BlocksCAD Inc. (H3XL spin-out)

- 2014 - present: Founder and member of Board of Directors. BlocksCAD is a visual Computer-Aided Design (CAD) program, designed to teach children mathematics and geometric visualization. BlocksCAD is being used in U.S. schools and worldwide in maker spaces, with 350,000+ users. BlocksCAD was selected to be part of the LearnLaunch 2017 Boost Accelerator, the MIT Play Labs 2018 Summer Accelerator, and the MassChallenge 2018 Boston Cohort. Recipient of DARPA DSO grant in 2014, and SBIR grant from the USDA in 2019.

H3XL Inc. d/b/a Einstein's Workshop (formerly Lexington Robotics)

- 2009 - 2022: Founder and President. Started a science, technology, engineering and math enrichment program and creative/maker space, in 7,000 square feet of space. Serve 2,000+ kids and families annually. As of end of 2022, have delivered an estimated 250,000 student-instruction-hours of STEM courses. Principle Investigator for 2-year DARPA grant to improve 3D Computer Aided Design tool developed in-house for the purposes of teaching 8 year olds and up 3D CAD.

Eons

- 2008 - 2009: Chief Technology Officer. Created product that Eons acquired from BBN Technologies. Integrated BBN product with Eons social networking platform and significantly increased the Eons group creation rate. Helped evaluate advertisement platform offerings and rolled out the "Boom Network" advertising network. Eons raised $32 million from General Catalyst Partners, Charles River Ventures, Sequoia Capital, and Intel Capital.

BBN Technologies

- 2007 - 2008: Delta Division, Vice President of Technology. Grew "Boomerang" counter-sniper project engineering team and significantly de-risked $10 million worth of product deliveries. Identified sales team leading to $10 million dollars of new sales within 6 months and $100+ million in additional orders in the following two years. Boomerang was a significant asset leading to the acquisition of BBN by Raytheon in 2009. Created new business plan and grew team; launched new fully-featured social networking web site in 5 months. Served as lead expert witness in patent infringement lawsuit, resulting in $58 million jury award to client; verdict for patents I testified on were upheld on appeal which resulted in a $120 million settlement.
- 2004 - 2007: Delta Division, Director of Technology, responsible for commercializing IP and creating new businesses. Hired and grew division's initial engineering team. Wrote three business plans, two of which were funded. For call center business plan, acted as general manager, hiring and managing engineering team, inside sales team, and identifying and recruiting a new general manager. Identified and recruited other key employees to Delta Division, including senior members of team leading to successful internal sales growth and spin-outs of projects. Contracted by BBN to BBN spin-out PodZinger as VP of Operations and Technology. Additional areas studied include mesh networking, network security, satellite communications, and semantic web.

PodZinger Inc. (BBN spin-out, also known as EveryZing and now RAMP)

- 2006: Vice President of Operations and Technology. Significantly upgraded capability of consumer-facing search site and redeployed web site from company to co-location facility. Identified key portions of infrastructure for upgrading and cost reduction. Helped write business plan, evaluating advertisement models of revenue. Hired in operations replacement and phased back to BBN.

Commonwealth Capital

- 2004: Entrepreneur-in-residence (informally), performed technical due diligence on business plans, brainstormed ideas for new businesses with venture partner. With venture partner, left for portfolio company BBN to form core of commercialization team.

Empirix, Inc./Teradyne, Inc.

- 2001 - 2004: Chief Technologist, Engineering Manager, Web Application Test Group. Researched potential new product areas; developed product plan and prototype. Responsible for three new and existing products. Managed off-shore development team. Chief architect for all web testing products. Re-architected core testing product, helped write javascript interpreter. Provided technical vision for core product.
- 2000 - 2001: Chief Technologist, Communication Infrastructure Test Group. Responsible for incorporating new technology internally, tracking new technologies, technical evaluation of partnerships and potential acquisitions. Helped develop division strategy. Developed plans which formed core capabilities for successful new products introduced in 2004-5.
- 2000 - 2001: Engineering Manager, Communications Infrastructure Test Group. Execution of new product plan developed in prior role. Grew team from four existing engineers to team of over 30 on immediate team and over 40 on project. Delivered new platform in one year. Platform and derivatives accounted for large portion of booked products for the division within 2 years and is currently (2008) a key portion of new product offerings.
- 2000: Empirix was formed as a spin-out of Teradyne in January 2000. Reported to CEO in carve-out of Empirix from Teradyne.
- 1999: (Teradyne) Director of Business Development, Software Test Units. Reported directly to Chairman of the Board/Founder and then to general manager of software test unit (6 divisions of Teradyne). Evaluated and researched acquisition and partnership candidates. Internally assessed technology position in market and gaps in product lines. Worked with senior division staff to develop new product strategies. Attended internal Teradyne divisional board meetings. Chairman served as my mentor.

3Com Corporation/NBX Corporation

- 1999: Software Engineer 5. Continued work after 3Com acquisition of NBX. Built cross-division relationships for new products and research directions. NBX was acquired by 3Com in March 1999.
- 1997 - 1999: (NBX) Senior Scientist and Engineer. Work in IP Telephony. Architected next-generation product. Protocol design and validation for core protocol now used tens of millions of times daily. Led team in integration of IP protocols into current product. Designed audio reconstruction algorithms. Developed applications for bug analysis and diagnosis of system

problems. Implementation of network simulator. Work on collaborative projects with external partners. Worked to identify gaps in product. Representative at numerous trade shows. Innovated novel methods of using product.

MIT Department of Electrical Engineering and Computer Science, Cambridge, MA

- 1991 - 1998: Research assistant, Telemedia Network Systems Group. Design, development, and implementation of Gigabit ATM network for distributed multimedia system. Studied host interface design issues. ATM network simulation.
- Spring 1989, Fall 1990, Spring 1995: Teaching assistant, Computation Structures digital systems course. (Spring 1995 Head TA)
- 1988 - 1989: Head laboratory teaching assistant for Computation Structures. Responsibilities included writing and revising lab assignments, and maintaining the lab.
- 1987: Laboratory teaching assistant for Computation Structures.
- 1987: Design, construction, and programming of 16-bit computer.

Agora Technology Group, Incorporated

- 1994 - 1996: Founder and CEO. Conceived and oversaw development of targeted advertising-supported Web sites. Responsible for company's vision and direction. Attended the first two WWW Conferences, presenting a workshop and paper at the first, and appearing on the "Commercialization and Economics of the Web" panel and chairing the "Where Commercial Services and the Web Are Headed" panel at the second. Sold company intact; is currently an operating stand-alone company.

AT&T Bell Laboratories, Holmdel, NJ

- 1989 - 1990: Implementation of cascadable all-optical fiber logic gate. Modelocking of all-fiber erbium laser. Construction of modelocked laser repetition rate booster. Strong optics laboratory and fiber optic experience.
- Summer 1988, 1987: Research in integrated optics. Analysis of rectangular waveguides using microwave modeling. Fabrication of integrated optical components.

Honors

- MIT Alumni Association Great Dome Award, 2010, Baker 60th Anniversary Reunion Co-Chair (highest group award given by MIT Alumni Association)
- MIT Alumni Association Presidential Citation Award (now known as Great Dome), 2008, Member of MIT Chairman's Salon committee
- MIT Alumni Association Bronze Beaver Award, 2007 (highest individual award given by MIT Alumni Association)
- MIT Alumni Association Volunteer Honor Roll, February 2004
- MIT Alumni Association Lobdell Award, 1999
- Boston Museum of Science Gold Pin for 1000 hours of Volunteer Service, April 1999
- MIT Alumni Association Presidential Citation Award (now known as Great Dome), 1997, Member of Alumni Online Communications Committee

Patents and Patent Publications

- U.S. Patent #9,697,231, H. Houh, J. Stern, R. Spina, M. Meteer, "Methods and apparatus for providing virtual media channels based on media search," July 4, 2017.
- U.S. Patent #9,697,230, H. Houh, J. Stern, "Methods and apparatus for dynamic presentation of advertising, factual, and informational content using enhanced metadata in search-driven media applications," July 4, 2017. See also WO2007056485.
- U.S. Patent #7,975,296, L. Apfelbaum, H. Houh, T. Mayberry and G. Friedman, "Automated security threat testing of web pages," July 5, 2011. See also US20030159063, WO2003067405.
- U.S. Patent #7,877,736, H. Houh and J. N. Stern, "Computer language interpretation and optimization for server testing," January 25, 2011. See also US20050138104, WO2005043300.
- U.S. Patent #7,801,910, H. Houh and J. N. Stern, "Method and apparatus for timed tagging of media content," September 21, 2010. See also US20070112837, US20090222442, WO2007056535.
- U.S. Patent #7,590,542, D. C. Williams, W. C. Hand, H. Houh, A. R. Seeley, "Method of Generating Test Scripts Using a Voice-Capable Markup Language," September 15, 2009. See also EP1530869, US20030212561, WO2003096663.
- U.S. Patent #6,967,963, H. H. Houh, P. Anderson, C. Gadda, "Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data," November 22, 2005. See also EP1060400, WO2000033092, CA2318774.
- U.S. Patent #5,144,375, M. C. Gabriel, H. H. Houh, N. A. Whitaker, "Sagnac Optical Logic Gate," September 1, 1992. Also issued as European Patent # EP0456422, July 23, 1997, German Patent #DE69126913, August 28, 1997
- U.S. Patent Application Publication No. 20020015387, "Voice Traffic Packet Capture and Analysis Tool for a Data Network" (Abandoned in 2007)
- U.S. Patent Application Publication No. 20020016708, "Method and Apparatus for Utilizing a Network Processor as Part of a Test System" (Abandoned in 2007)
- U.S. Patent Application Publication No. 20020016937, "Method and Apparatus for Utilizing a Network Processor as Part of a Test System." (Abandoned in 2007) See also WO2002011413.
- U.S. Patent Application Publication No. 20070106646, "User-directed navigation of multimedia search results" (Abandoned in 2009)
- U.S. Patent Application Publication No. 20070106660, "Method and apparatus for using confidence scores of enhanced metadata in search-driven media applications" (Abandoned in 2009)
- U.S. Patent Application Publication No. 20070106685, "Method and apparatus for updating speech recognition databases and reindexing audio and video content using the same" (Abandoned in 2015)
- U.S. Patent Application Publication No. 20070118873, "Methods and apparatus for merging media content" (Abandoned in 2015)
- U.S. Patent Application Publication No. 20090222442, "User-directed navigation of multimedia search results" (Abandoned in 2016)
- U.S. Patent Application 11/395,732, "Search snippet creation for audio and video data" (Abandoned in 2009)
- U.S. Patent Application 11/774,931, "Methods and apparatus for managing a social networking web site"
- U.S. Patent Application 11/774,947, "Methods and apparatus for organizing media files"
- U.S. Patent Application 11/774,956, "Methods and apparatus for managing an online event"

- U.S. Provisional Patent Application 61/086,909, “Measuring and ranking relationship activity”
- U.S. Provisional Patent Application 61/086,914, “Detecting media object commonality”
- U.S. Provisional Patent Application 61/086,904, “Message categorization based on message characteristics”
- U.S. Provisional Patent Application 61/086,905, “Photo tagging to request action”

Trials, Testimony and Depositions

- Case No. 1:06CV682 (CMH/BRP), Verizon vs. Vonage, U.S. District Court for the Eastern District of Virginia, filed expert report, was deposed and testified at trial.
- Case No. 1:08CV157 (CMH/TRJ), Verizon vs. Cox, U.S. District Court for the Eastern District of Virginia, was deposed and testified at trial.
- Case No. 5:09-cv-476, Two-Way Media vs. AT&T, U.S. District Court for the Western District of Texas, filed expert report, testified at trial.
- Case No. 2:10-cv-248 (RAJ/FBS), ActiveVideo Networks vs. Verizon, U.S. District Court for the Eastern District of Virginia, filed expert report and was deposed as an expert witness.
- Case No. 1:11-cv-00880-TSE-JFA, Bear Creek Technologies, Inc. vs. Verizon Services Corp., et al, U.S. District Court for the Easter District of Virginia, was deposed as an expert witness.
- Case No. 3:10-CV-298-BBC, AlmondNet, Inc. vs. Microsoft Corp., U.S. District Court for the Western District of Wisconsin, filed expert report.
- Case No. 6:10-cv-00597, Guardian Media Technologies, Ltd. Vs. AT&T Operations, Inc. et al., U.S. District Court for the Eastern District of Texas, Tyler Division, filed expert report.
- Case No. ESCV2010-02282C, The Octopus Solution LLC v. Gary Brown et al., Essex, MA Superior Court, testified at trial.
- Investigation No. 337-TA-882, In the matter of Certain digital media devices, including televisions, Blu-ray disc players, home theater systems, tablets and mobile phones, components thereof and associated software, U.S. International Trade Commission, filed expert reports, was deposed and testified at hearing.
- Investigation No. 337-TA-995, In the matter of Certain communications or computing devices, and components thereof, U.S. International Trade Commission, filed expert reports, and was deposed.
- Case No. 8:12-cv-122-LES-TDT, Prism Technologies LLC v. AT&T Mobility LLC, U.S. District Court for the District of Nebraska, filed expert report, was deposed and testified at trial.
- Case No. 11-2684 (JWL), Sprint Communications Co., L.P., v. Comcast Cable Communications, LLC, et al., U.S. District Court for the District of Kansas, filed expert report and was deposed.
- Case No. 11-2686 (JWL), Sprint Communications Co., L.P., v. Time Warner Cable, Inc., et. al., LLC, et al., U.S. District Court for the District of Kansas, filed expert report, was deposed, and testified at trial.
- Case No. 12-487 (SLR), Cox Communications, Inc., et al., v. Sprint Communications Company L.P., et al., U.S. District Court for the District of Delaware, filed expert report and was deposed.
- Case IPR 2014-00039, Microsoft Corporation v. B.E. Technology LLC, U.S. Patent No. 6,628,314. Submitted declaration and cross-examined in deposition.
- Case IPR 2014-00086, Apple, Inc. v. Evolutionary Intelligence, LLC, U.S. Patent No. 7,010,536. Submitted declaration and cross-examined in deposition.
- Case No. 6:11-CV-421, Stragent, LLC v. Intel Corporation, U.S. District Court for the Eastern District of Texas, Tyler Division, deposed and testified at trial as a fact witness.

- IPR2014-01366, IPR2014-01367, IPR2014-01368, Samsung et al. v. Straight Path, submitted IPR declarations and was deposed.
- IPR2015-1006, IPR2015-1007, Cisco v. Straight Path, submitted IPR declarations.
- IPR2014-01457, IPR2014-01459, Microsoft v. Biscotti, submitted IPR declaration and was deposed.
- IPR2016-00302, Apple v. Nonend, submitted IPR declaration.
- IPR2014-00812, Yelp and Twitter v. Evolutionary Intelligence, submitted IPR declaration.
- IPR2015-00307, Cisco v. AIP, submitted IPR declaration.
- Microsoft v. Acacia, submitted IPR declaration.
- IPR2015-00342, AT&T Mobility LLC and Cellco Partnership d/b/a Verizon Wireless v. Solocron, submitted IPR declaration.
- Mediatube v. Bell Canada, Canadian Federal Court, submitted expert report and testified at trial.
- CBM2016-00036, Google v. At Home Bondholder's Liquidating Trust, submitted CBM declaration.
- IPR2016-01198, IPR2016-01201, Apple, Inc. v. VoIP-Pal.com, Inc., submitted IPR declaration and was deposed.
- Case No. 3:14-cv-2824-VC, Trend Micro Incorporated v. Rpost Holdings, Inc., et al, submitted expert report and was deposed
- Akamai v. Limelight Networks, IPR2016-01631, IPR2016-01711, IPR2017-00249, IPR2017-00349, submitted IPR declarations and was deposed
- Hyperlync Technologies v. Verizon Sourcing, No. 650151/2015 New York Supreme Court, submitted declaration and was deposed
- Cascades Streaming Technologies v. Big Ten Networks, submitted expert reports and was deposed
- Klaustech, Inc. v. Google LLC., Case No. 4:10-CV-05899-JSW (N.D. Cal.), submitted expert report and was deposed
- Cisco v. Uniloc, IPR2017-00198, IPR2017-00058, submitted IPR declarations and was deposed.
- Cisco v. Uniloc, IPR2017-00597, submitted IPR declaration and was deposed
- Twitter v. Youtoo Technologies, LLC, IPR2017-01133, IPR2017-01131, submitted IPR declarations and was deposed
- Taser International Inc. (now Axon Enterprise, Inc.) v. Digital Ally Inc., IPR2017-00375, submitted IPR declaration and was deposed
- Taser International Inc. (now Axon Enterprise, Inc.) v. Digital Ally Inc., IPR2017-00376, IPR2017-00515, IPR2017-00775, submitted IPR declarations
- HTC Corporation v. IPA Technologies, IPR2018-00306, IPR2018-00307, submitted IPR declaration
- Hulu v. Soundview, IPR2018-00864, IPR2018-01023, submitted IPR declarations and was deposed
- XpertUniverse v. Cisco, 3:17-cv-3848, U.S. District Court for Northern District of California, submitted declaration in support of claim construction and was deposed
- Improved Search v. Microsoft, C.A. No. 16-cv-650-JFB-SRF (Del.), submitted declaration in support of claim construction
- Apple v. Uniloc, IPR2018-00361, IPR2018-00394, IPR2018-00395, IPR2019-00700, IPR2019-00701, IPR2019-01667, submitted IPR declarations
- LG Electronics v. Uniloc, submitted IPR declaration
- SRC Labs and Saint Regis Mohawk Tribe v. Microsoft, 2:18-cv-00321-JLR, U.S. District Court for Western District of Washington at Seattle, submitted declaration in support of claim construction and was deposed

- Verizon Wireless v. Barkan Wireless IP Holdings LP, submitted IPR declarations
- Verizon Wireless and Samsung Electronics America Inc. v. Barkan Wireless IP Holdings LP, IPR2019-199, IPR2019-200, IPR2019-234, IPR2019-631, IPR2019-632, submitted IPR declarations
- Samsung Electronics America Inc. v. Barkan Wireless IP Holdings LP, IPR2019-100, submitted IPR declaration
- Cisco Systems Inc. v. Meetrix IP LLC, IPR2019-539, IPR2019-540, IPR2019-541, IPR2019-542, IPR2019-543, IPR2019-544, submitted IPR declarations
- GMG Products LLC v. Traeger Pellet Grills LLC, PGR2019-24, PGR2019-34, PGR2019-35, PGR2019-36, submitted PGR declaration and was deposed
- Uniloc 2017 LLC v. Google LLC, 2:18-cv-00502-JRG-RSP, U.S. District Court for the Eastern District of Texas, Marshall Division, submitted declaration in support of claim construction
- Microsoft Corporation v. Uniloc 2017 LLC, IPR2020-00102, IPR2020-00103, submitted IPR declarations
- Microsoft Corporation and HP Inc. v. Synkloud Technologies, LLC, IPR2020-00316, IPR2020-01031, IPR2020-01032, IPR2020-01269, IPR2020-01270, IPR2020-01271, submitted IPR declarations
- Seven Networks, LLC v. Apple Inc, 2:19-cv-115-JRG, U.S. District Court for the Eastern District of Texas, Marshall Division, submitted declaration in support of claim construction
- Unified Patents Inc. v. Ortiz & Associates Consulting, LLC, IPR2019-00743, submitted IPR declaration
- Uniloc 2017 LLC v. Apple Inc., 3:19-cv-01905-JD, U.S. District Court for the Northern District of California, San Francisco Division, submitted declaration in support of claim construction and was deposed
- ClearPlay Inc. v. Dish Network LLC et al.; 2:14-cv-00191, U.S. District Court for the District of Utah, Central Division, submitted expert report and re-examination declarations, was deposed, and testified at trial
- AMC Networks, Inc. et al v. Sound View Innovations, LLC, IPR2020-00482, submitted IPR declaration
- Case No. 1:17-cv-01734-RGA, Sprint Communications Co., L.P., v. Charter Communications, Inc., et al., U.S. District Court for the District of Delaware, filed expert report and was deposed.
- CommScope Technologies LLC et al. v. Barkan Wireless IP Holdings LP et al., IPR2020-00827, IPR2020-00829, IPR2020-00831, IPR2020-00833, IPR2020-00835, IPR2020-00838, submitted IPR declarations
- Cisco Systems Inc. v. Monarch Networking Solutions LLC, IPR2020-01226, submitted IPR declaration
- CoolTV Network.com v. Blackboard, Inc., Facebook, Inc., International Business Machines Corporation, Kaltura, Inc., Limelight Networks, Inc., Microsoft Corporation, Ooyala, Inc., Snap, Inc., and Trapelo Corp., submitted declaration in support of claim construction and was deposed
- Facebook, Inc. v. Onstream Media Corporation, IPR2020-01507, IPR2020-01508, IPR2020-01525, IPR2020-01527, IPR2020-01528, submitted IPR declarations
- Hisense Co LTD. v. Maxell, LTD, IPR2020-01598, IPR2020-01600, submitted IPR declarations
- Microsoft Corp. v. O'Brien, IPR2021-00015, submitted IPR declaration and was deposed
- Sable Networks Inc. v. Cisco Systems, Inc., WA:20-CV-00288-ADA, U.S. District Court for the Western District of Texas, Waco Division, submitted declaration in support of claim construction
- Peloton Interactive, Inc. v. Icon Health and Fitness Inc et al., IPR2021-00342, submitted IPR declaration

- Hulu, LLC v. SITO Mobile R&D IP, LLC et al., CBM2020-00028, IPR2020-00158, IPR2020-00206 , IPR2020-00219 , IPR2020-00265 , IPR2020-00298 , IPR2020-00304 , IPR2020-00308 , submitted CMB and IPR declarations and was deposed
- Twitter, Inc. and Google LLC v. B.E. Technology, LLC, IPR2021-00482, IPR2021-00483, IPR2021-00484, IPR2021-00485, submitted IPR declarations
- MG Freesites LTD v. ScorpCast, LLC, IPR2021-00511, submitted IPR declaration
- Avionte, LLC v. Sandeep Acharya, Samar Basnet, and Aqore LLC, Arbitration, Hon. Jeffrey Keyes (Ret.)
- Microsoft Corporation v. WSOU Investments, LLC d/b/a Brazos Licensing and Development, IPR2021-00751, submitted IPR declaration
- SAP America, Inc. v. Express Mobile, Inc., IPR2021-01144, IPR2021-01145, IPR2021-01146, submitted IPR declarations
- StratosAudio Inc. v. Hyundai Motor America, 6:20-cv-01125-ADA, U.S. District Court for the Western District of Texas, Waco Division, submitted claim construction declaration and was deposedPeloton Interactive, Inc. v. Ifit Health and Fitness Inc, IPR2022-00029, IPR2022-00030, submitted IPR declarations and was deposed
- Investigation No. 337-TA-1263, In the matter of Certain televisions, remote controls, and components thereof, U.S. International Trade Commission, filed expert reports, was deposed, and testified at hearing
- Alexander Stross v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00861-AB(JC), filed expert reports, and was deposed
- Ralph Ledergerber v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00862-AB(JC), filed expert reports and was deposed
- John Walmsley v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00863-AB(JC), filed expert reports and was deposed
- Bernhard Kuhmstedt v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-02044-AB(JC), filed expert reports and was deposed
- Netflix, Inc. v. CA, Inc., IPR2021-01319, submitted IPR declaration and was deposed
- F45 Training Pty Ltd. v. Body Fit Training USA Inc., C.A. No. 20-1194 (LPS) (D. Del.), filed expert report
- Apple v. Fintiv, IPR2022-00976, IPR2022-01149, IPR2022-01150, IPR2023-00399, submitted IPR declarations and was deposed
- Estech Systems, Inc. v. Howard Midstream Energy Partners d/b/a Howard Energy Partners, C.A. No. 6:20-cv-777-ADA (Western District of Texas, Waco Division), filed expert reports and was deposed
- Echelon Fitness Multimedia, LLC. v. Peloton Interactive, Inc., IPR2020-01187, submitted IPR declaration and was deposed
- VIZIO. V. Maxell Ltd., IPR2022-01458, submitted IPR declaration
- Maxell, Ltd. et. el. v. VIZIO, Inc., Case No. 2-21-cv-06758 (C.D. Cal.). filed declaration and was deposed
- Microsoft Corporation v. SurfCast, Inc., submitted IPR declarations
- The Walt Disney Company et. al. v. WAG Acquisition LLC, IPR2022-01227, IPR2022-01228, IPR2022-01346, submitted IPR declarations and was deposed
- Rakuten Rewards et. al. v. IBM, submitted IPR declarations and was deposed
- Fubotv Media Inc. v. Sito Mobile R&D IP, LLC et. al., submitted IPR declarations
- Unified Patents, LLC v. Noblewood IP LLC, IPR2022-01111, submitted IPR declaration
- Unified Patents, LLC. v. Pedersen, Peter Henrik, IPR2023-00029, submitted IPR declaration
- Ericsson Inc v. Dali Wireless Inc., submitted IPR declarations

- Universal Electronics, Inc. et. al. v. Roku, Inc., IPR2022-00818, submitted declarations and was deposed
- Google LLC. v. Wildseed Mobile LLC et. al., IPR2023-00244, IPR2023-00245, IPR2023-00246, IPR2023-00247, IPR2023-00248, submitted declarations
- Lululemon Athletica Canada Inc. et. al. v. Nike, Inc., IPR2023-00180, IPR2023-00424, submitted declarations
- Zoho Corporation, et. al. v. Meetrix IP, LLC, IPR2023-00371, IPR2023-00377, IPR2023-00379, IPR2023-00380, IPR2023-00382, submitted declarations
- WSOU Investments, LLC d/b/a/ Brazos Licensing and Development v. Google LLC, 6:20-cv-572, U.S. District Court for the Western District of Texas, Waco Division, submitted reports and was deposed
- Google LLC v. Safecast Limited LLC, IPR2023-00652, submitted declaration
- Investigation No. 337-TA-1338, In the matter of Certain smart televisions, U.S. International Trade Commission, filed reports and was deposed
- Cisco Systems, Inc. v. Orckit IP LLC, IPR2023-00714, submitted declaration
- SupplyPro, Inc. v. Sandvik Machining Solutions AB, et. al., AAA Case No. 01-22-000-7897. submitted declaration
- TrackThings LLC v. NETGEAR, Inc., Case No. 22-00981-RGA-JLH, U.S. District Court for the District of Delaware, submitted declaration
- Walt Disney Parks & Resorts US Inc. v. Agile Journeys LLC; IPR2024-00029, submitted declaration
- Aylo Freesites Ltd v. Dish Technologies LLC; IPR2024-00043, IPR2024-00044, IPR2024-00045, IPR2024-00046, IPR2024-00047, IPR2024-00048, IPR2024-00146, IPR2024-00147; submitted declarations

Publications

- "IP switching: server driven flow classification," H. H. Houh, *Proceedings of the Washington University Workshop on Integration of IP and ATM* , November 1996.
- "Aurora at MIT," D. D. Clark, H. H. Houh, and D. L. Tennenhouse, Editors, *MIT Laboratory for Computer Science Technical Report 673*, December 1995.
- "ViewStation Applications: Implications for Network Traffic," C. J. Lindblad, D. Wetherall, W. Stasior, J. F. Adam, H. H. Houh, M. Ismert, D. Bacher, B. Phillips, and D. L. Tennenhouse, *IEEE Journal of Selected Areas in Communications*, 1995.
- "The VuNet Desk Area Network: Architecture, Implementation, and Experience," H. H. Houh, J. F. Adam, M. Ismert, C. J. Lindblad, and D. L. Tennenhouse, *IEEE Journal of Selected Areas in Communications*, 13 (4), May, 1995.
- "Reducing the Complexity of ATM Host Interfaces," H. H. Houh and D. L. Tennenhouse, Hot Interconnects II Symposium Proceedings, Stanford, August 11-12, 1994.
- "Media-intensive data communications in a `desk-area' network," J. F. Adam, H. H. Houh, M. Ismert, and D. L. Tennenhouse, IEEE Communications, August 1994.
- "ViewStation Applications: Intelligent Video Processing Over A Broadband Local Area Network," C. J. Lindblad, D. J. Wetherall, W. Stasior, B. Phillips, D. Bacher, J. Adam, H. Houh, M. Ismert, and D. L. Tennenhouse, Proceedings of the 1994 USENIX Symposium on High-Speed Networking, Oakland, CA, August 1994.

- "The Media Gateway: Live Video on the World Wide Web," H. H. Houh, C. J. Lindblad, J. Soo, D. L. Tennenhouse, and D. J. Wetherall, Workshop at the 1994 World Wide Web Conference, Geneva, Switzerland, May 1994.
- "Active Pages: Intelligent Nodes on the World Wide Web ," H. H. Houh, C. J. Lindblad, and D. J. Wetherall, Proceedings of the 1994 World Wide Web Conference, Geneva, Switzerland, May 1994.
- "Wavelength Division vs. Code Division Access Methods for Optical Networks," H. H. Houh, Area Exam Paper, May 1993.
- "Experience with the VuNet: A Network Architecture for a Distributed Multimedia System," J. F. Adam, H. H. Houh, D. L. Tennenhouse, Proceedings of the 18th Conference on Local Computer Networks, pp. 70-76, September 1993
- "The VudBoard: A Simple DMA Interface," H. H. Houh, Proceedings of the 4th Gigabit Minijam, January 1994.
- "A Software-Oriented Approach to the Design of Media Processing Environments," D. L. Tennenhouse, J. Adam, D. Carver, H. Houh, M. Ismert, C. Lindblad, W. Stasior, D. Weatherall, D. Bacher, and T. Chang., submitted to the International Conference on Multimedia Computing and Systems, May 1994.
- "A Network Architecture for Distributed Multimedia Systems," J. F. Adam, H. H. Houh, M. Ismert, and D. L. Tennenhouse, submitted to the International Conference on Multimedia Computing and Systems, May 1994.
- "The Viewstation Collected Papers," D. L. Tennenhouse, J. Adam, C. Compton, A. Duda, D. Gifford, H. Houh, M. Ismert, C. Lindblad, W. Stasior, R. Weiss, D. Wetherall, D. Bacher, D. Carver, and T. Chang, MIT Laboratory for Computer Science Technical Report, MIT/LCS/TR-590, November 1993.
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- "Complete Switching in a Three-Terminal Sagnac Switch," H. Avramopoulos, P. M. W. French, M. C. Gabriel, H. H. Houh, N. A. Whitaker, T. Morse, IEEE Phot. Tech. Lett. **3** (3), 235
- "Complete Switching in a Three-Terminal Sagnac Switch," H. Avramopoulos, P. M. W. French, M. C. Gabriel, H. H. Houh, N. A. Whitaker, IEEE/LEOS Annual Meeting, Paper PDP-13, November 1990
- "All-optical phase-locked oscillator," N. A.Whitaker, Jr., H. H. Houh, H. Avramopoulos, T. F. Morse, IEEE/LEOS Annual Meeting, Paper ELT2.4/MOO3, November 1990
- "Passive modelocking of an all-fiber erbium laser," H. Avramopoulos, H. H. Houh, N. A. Whitaker, M. C. Gabriel, T. F. Morse, IEEE/LEOS Conference on Optical Amplifiers and their Applications, Paper PDP-8, August 1990
- "Transverse modes, waveguide dispersion, and 30ps recovery in submicron GaAs/AlAs microresonators," J. L. Jewell, S. L. McCall, A. Scherer, H. H. Houh, N. A. Whitaker, A. C. Gossard, and J. H. English, Appl. Phys. Lett. **55** (1), July 3, 1989

Leadership, Activities and Interests

- Leadership
  - Reading Symphony Orchestra
    - Board of Directors (Treasurer), 2022 - present
  - Discovery Museums (Acton, MA)
    - Board of Directors, 2023 – present
    - Board of Directors, Development Committee, 2023 – present
    - Science and Technology Advisory Council, 2012 - present
  - Tau Beta Pi National Engineering Honor Society
    - Executive Councilor Elect, to serve 2024-2026
    - Advisor, MA B Chapter at MIT, 2003 - present
    - District Director (National Officer), Tau Beta Pi, New England Area, 1991 - 2003
    - President, MA B Chapter at MIT, Fall 1988 - Spring 1989
    - Laureate award, 1989
  - MIT Alumni Association Board of Directors
    - National Selection Committee, 3 year term, 2020 – 2023
    - K-12 STEM Initiatives Co-chair, 2013 – 2017
    - Awards Committee Chair, 2012 – 2014
    - Awards Committee, 3 year term, 2011 – 2014
    - Vice President, 2 year term, 2004 – 2006
    - Alumni Ad-Hoc Committee, Chair, 2005-2006
    - Board Member, 2 year term, 1997 – 1999
  - MIT Club of Boston
    - Board of Directors, 2006 - 2011
    - K-12 Initiatives Chair, 2009 - 2012
    - VP of Communications, MIT Club of Boston, 2003 - 2006
    - Past-President, MIT Club of Boston, 2002 - 2003
    - President, MIT Club of Boston, 2001 - 2002
    - President-Elect, MIT Club of Boston, 2000 - 2001
    - VP of Programs, MIT Club of Boston, 1999 - 2000
    - Activities Super-Chair, MIT Club of Boston, 1998 - 1999
  - MIT Enterprise Forum of Cambridge, Inc.
    - Past Chair, 2009 – 2011
    - In-NOW-vation Co-chair, 2010
    - Chair, 2007 - 2009
    - Vice Chair, 2005 - 2007
    - Executive Board Member, 2002 - 2011
    - Winter Workshop Co-Chair, February 2007 - conceived idea for conference, which sold-out and produced largest attendance numbers in recent memory
    - Spring Workshop Co-Chair, Spring 2004
    - Membership Committee Chair, Fall 2003 - 2006
    - 25th Anniversary Dinner Chair, Fall 2003
    - As Membership Chair and Board Member, started Special Interest Groups in 2004; a SIG won the MIT Presidential Citation award, the MIT Alumni Association's highest award for organizations, in 2006
  - Estabrook Elementary School PTA

        - Advisory committee to the superintendent on PCB issue, 2010-2011
        - 4th Grade after-school science program co-organizer, 2010-2012
        - 4th and 5th Grade before-school Math Olympiad co-organizer, 2009-2013
        - 5th Grade BBQ and Yearbook Committee, 2011, 2013
        - Family Math Night volunteer, 2008-2012
    - MIT Class of 1989
        - Secretary, five consecutive 5 year terms, 1989 - 2014
        - 30-year Reunion Committee, 2019
        - 25-year Reunion Committee, 2014
        - 20-year Reunion Committee and Gift Committee, 2009
        - 15-year Reunion Committee and Gift Committee, 2004
        - 10-year Reunion Committee and Gift Committee, 1999
        - 5-year Reunion Committee, 1994
        - Interim Treasurer, 1993 - 1994
        - Instituted annual senior class career fair, now raising over $100,000 annually for senior class activities, Fall 1988
    - Strong, consistent record of leadership dating to high school
- Acting
    - '21' (Sony Pictures), credited as "Chinatown Dealer," 2007, Kevin Spacey's movie about the MIT Blackjack Team inspired by "Bringing Down the House" by Ben Mezrich, opened nationwide on March 28, 2008. 21 was the number one movie in US for two weeks and number one globally for one week. 21 also topped the DVD sales, Blu-ray sales and DVD rental charts.
    - Spring Lake Theater Company, first New York-area off-broadway production of "A Chorus Line," played role of Mark, Summer 1990
- Former member of the MIT Blackjack team
- Producer for 10,000 Maniacs' 2013 album "Music from the Motion Picture"
- Executive Producer for 10,000 Maniacs' 2015 album "Twice Told Tales"
- Violist, violist, harpist, guitarist, singer, actor: played in many amateur/semi-professional groups including Firebird Pops Orchestra, Reading Symphony Orchestra, MIT Summer Philharmonic Orchestra, Carlisle Chamber Orchestra, Rivers Symphony Orchestra, Opera51 Orchestra, Freisinger Chamber Orchestra, Merrimack Valley Philharmonic, Longwood Symphony, MIT Symphony, and Somerville Community Chorus
- Violist, "Coming Home" album by Karen Phillips, 2014
- Google Scholar citations: 2079, h-index: 21, i10-index: 26 (since 2017: 662/12/14)
- Erdos-Bacon number of 7
- Erdos-Bacon-Sabbath number of 11