

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZOOM COMMUNICATIONS, INC.,

Petitioner

v.

RICOH COMPANY, LTD.

Patent Owner

IPR2026-00411

U.S. Patent No. 11,256,464 B2

CORRECTED DECLARATION OF DR. KEVIN C. ALMEROOTH

REGARDING U.S. PATENT NO. 11,256,464

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PETITIONER'S EXHIBIT LIST

No.	Reference	Referred To As
1001	U.S. Patent No. 11,256,464	'464 Patent
1002	Prosecution History of U.S. Patent No. 11,256,464	'464 Patent File History
1003	Declaration of Dr. Kevin Almeroth	Almeroth Decl.
1004	UK Patent Application Publication No. GB 2473463 A	Watson
1005	U.S. Patent No. 5,990,931	Nimri
1006	U.S. Patent No. 8,994,778	Weiser
1007	U.S. Patent Application Publication No. 2011/0271211	Jones
1008	U.S. Patent Application Publication No. 2010/0306674	Salesky
1009	U.S. Patent Application Publication No. 2010/0053341	Yi
1010	U.S. Patent Application Publication No. 2012/0154256	Grover
1011	Microsoft Office 2004 Review CNET, <i>Available at</i> https://www.cnet.com/reviews/microsoft-office-2004-for-mac-standard-edition-review/y .	Office 2004

LISTING OF CHALLENGED CLAIMS

Claim	Limitation
1.	A communication device connected to an image capturing apparatus, a first display, and a second display, the communication device comprising:
[1.a]	a transceiver to transmit data of a first captured image captured by the image capturing apparatus via a network; and receive data of a second captured image via the network; and
[1.b]	receive data of a third image that is displayed on a display of another communication device via the network, the third image being different than the first captured image and the second captured image; and
[1.c]	a display control circuit configured to control the first display and the second display; and in response to supply of the third image being finished while the first display displays the first captured image and the second captured image and the second display displays the third image, automatically control the first display to display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image.
2.	The communication device according to claim 1, wherein the third image comprises one of a desktop screen and a user interface of an application program.
3.	The communication device according to claim 1, wherein the third image comprises an image created by using one of word-processing software, spreadsheet software, and presentation software.
4.	The communication device according to claim 1, further comprising: an operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme, wherein according to the first display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display none of the first captured image, the second captured image, and the third image, and according to the second display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display the third image.
5.	A method implemented by a communication device connected to an image capturing apparatus, a first display, and a second display, the method comprising:

[5.a]	transmitting data of a first captured image captured by the image capturing apparatus via a network; receiving data of a second captured image via the network;
[5.b]	receiving data of a third image that is displayed on a display device of another communication device via the network, the third image being different from the first captured image and the second captured image;
[5.c]	controlling the first display and the second display; and in response to supply of the third image being finished while the first display displays the first captured image and the second captured image and the second display displays the third image, automatically controlling the first display to display the first captured image and the second captured image, and controlling the second display to display none of the first captured image, the second captured image, and the third image.
6.	The method according to claim 5, wherein the third image comprises one of a desktop screen and a user interface of an application program.
7.	The method according to claim 5, wherein the third image comprises an image created by using one of word-processing software, spreadsheet software, and presentation software.
8.	The method according to claim 5, further comprising: receiving an instruction to change between a first display scheme and a second display scheme; in a case that the instruction indicates to change to the first display scheme, controlling the first display to display the first captured image and the second captured image and controlling the second display to display none of the first captured image, the second captured image, and the third image; in a case that the instruction indicates to change to the second display scheme, controlling the first display to display the first captured image and the second captured image and controlling the second display to display the third image.
9.	A non-transitory computer readable medium storing computer executable instructions which, when executed by circuitry of a computer, cause the computer to:
[9.a]	transmit data of a first captured image captured by an image capturing apparatus via a network; receive data of a second captured image via the network; and

[9.b]	receive data of a third image that is displayed on a display of another device via the network, the third image being different than the first captured image and the second captured image; and
[9.c]	control a first display and a second display; and in response to supply of the third image being finished while the first display displays the first captured image and the second captured image and the second display displays the third image, automatically control the first display to display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image.
10.	<p>The non-transitory computer readable medium according to claim 9, wherein the computer is further caused to:</p> <p>receive an instruction to change between a first display scheme and a second display scheme;</p> <p>in a case that the instruction indicates to change to the first display scheme, control the first display to display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image;</p> <p>in a case that the instruction indicates to change to the second display scheme, control the first display to display the first captured image and the second captured image and control the second display to display the third image.</p>

I. INTRODUCTION

A. Engagement

1. I, Dr. Kevin C. Almeroth, have been retained by counsel for Zoom Communications, Inc. (“Petitioner”) to provide my expert opinions regarding U.S. Patent No. 11,256,464 (“the ’464 Patent”), which is assigned to Ricoh Company, Ltd. (“Patent Owner”). I have been asked to evaluate the validity of claims 1-10 of the ’464 Patent in light of the prior art. I understand that my opinions will be submitted in support of a Petition for Inter Partes Review before the United States Patent and Trademark Office, Patent Trial and Appeal Board. This declaration sets forth my opinions and the bases for those opinions.

B. Background and Qualifications

2. My complete qualifications and professional experience are described in my curriculum vitae, a copy of which is provided as Appendix A. The following is a summary of my relevant qualifications and professional experience.

3. I am currently Professor Emeritus in the Department of Computer Science at the University of California, Santa Barbara (UCSB). I have been a faculty member at UCSB since July 1997. At UCSB, I held faculty appointments and was a founding member of the Computer Engineering Program, the Media Arts and Technology Program, and the Technology Management Program. I served as Associate Director of the Center for Information Technology and Society from 1999 to 2012. My administrative roles have included Vice Chair of Computer Science

from July 2000 through November 2005 and Associate Dean of the College of Engineering from March 2007 through August 2009.

4. I hold three degrees from the Georgia Institute of Technology. I received a B.S. degree in Information and Computer Science with high honors in June 1992, with minors in Economics, Technical Communication, and American Literature. My undergraduate work included courses typical of electrical engineering, including digital logic, signal processing, and telecommunications theory. I received an M.S. degree in Computer Science in June 1994, with a specialization in Networking and Systems. I received a Ph.D. degree in Computer Science in June 1997. My doctoral dissertation was titled “Networking and System Support for the Efficient, Scalable Delivery of Services in Interactive Multimedia Systems,” and I completed a minor in Telecommunications Public Policy.

5. For more than 30 years, my research has focused on the delivery of multimedia content and data between computing devices. This encompasses network architectures, large-scale content delivery systems, scalable delivery of content to hundreds or thousands of users simultaneously, and smaller-scale content exchange between computers and portable devices. My research has emphasized efficient content exchange across networks, scalable content delivery, mobile computing, satellite networking, delivery to mobile devices, and wireless data delivery.

6. Beginning in 1992, my research focused on interactive functions for near video-on-demand systems, including VCR-style functions such as pause, rewind, and fast-forward, and aggregation of requests for movies using one audio/video stream broadcast to multiple receivers. I have researched communicating multimedia content, including video, between computers across networks including the Internet, including streaming multimedia content and multicast protocols for efficient delivery to multiple endpoints simultaneously.

7. Starting in 1997, I worked on integrating Internet streaming media with web interactivity through a system called the Interactive Multimedia Jukebox (IMJ), where users selected content via a web page and content was scheduled and delivered through multicast channels. The IMJ combined web interactivity with Internet streaming to create a jukebox-like service supporting Video-on-Demand when capacity allowed and scalable service to many users. This work is directly relevant to the subject matter of the '464 Patent because it involved the integration of interactive user interface controls with real-time multimedia delivery across networked systems.

8. Since 1997, I have also researched wireless devices and sensors, lightweight devices, small form-factor and resource-constrained devices, wireless networking, ad hoc networks, mesh networks, and wireless protocols. My wireless networking work spans the protocol stack from applications through data link and

physical layers. My research includes application development for mobile platforms, opportunistic contact among mobile devices, wireless infrastructure support, challenged network environments, network monitoring, IEEE 802.11 networks, channel bonding, location information, handoffs, and location and movement prediction.

9. Since 2000, I have worked on network security, firewalls, intrusion detection, malware detection, and a Department of Defense/Army Research Office high-speed intrusion detection project. I have also investigated content delivery in online social networks, caching and cache placement strategies, reputation management systems, peer-to-peer communication architectures, and recommendations for downloadable applications.

10. One of my early research interests was in using technology in the classroom to aid in instruction. An initial concern was that too much technology, or technology used incorrectly could be a distraction. Therefore, starting in the late 1990s, I undertook research to first figure out what technology could be used in the classroom and then continued on with research to understand its effectiveness. This work included the design, deployment, and study of digital classroom systems, including work to build infrastructure for a next-generation digital classroom. It also led to a broader set of projects and publications involving classroom activity monitoring, network access controls, plagiarism detection, clicker-based interaction

in large lecture courses, and tools for measuring student engagement and learning in computer-equipped classrooms.

11. I have been involved in the Internet Engineering Task Force (IETF), including content-delivery and multicast-related working groups: AVT, MBONED, SSM, IDMR, RMT, and PIM. I served on the Multicast Directorate and chaired the Internet2 Multicast Working Group for seven years. I co-founded Santa Barbara Labs, which developed emulation systems for the U.S. Air Force's next-generation internetwork, including systems for IPv6, multicast, quality of service, satellite communication, security, video conferencing, and video-on-demand.

12. I have consulted with or collaborated with IBM, Hitachi Telecom, Turner Broadcasting System, Bell South, Digital Fountain, RealNetworks, Intel Research, Cisco Systems, and Lockheed Martin. I have held leadership roles in academic journals and conferences, including ACM NOSSDAV, ICNP, CHANTS, IEEE Global Internet Symposium, IEEE/ACM Transactions on Networking, IEEE Transactions on Mobile Computing, IEEE Network, ACM Computers in Entertainment, and ACM Computer Communications Review. I am a Fellow of IEEE and a member of ACM.

13. I have taught courses covering Internet and network communication, physical and data link layers, cable systems, telephone lines, wireless communication, high-speed LANs, data communication, multimedia encoding,

mobile application design, and infrastructures including cable, ISDN, Ethernet, ATM, fiber, and DSL. I received the UCSB Academic Senate Distinguished Teaching Award in 2006-2007, multiple Computer Science Outstanding Faculty Member awards, and the UCSB Spotlight on Excellence Award. Additional details of my education and work experience, awards and honors, and publications that may be relevant to the opinions I have formed are set forth in my CV, attached hereto as Appendix A.

14. Based on my education and experience, I am familiar with the state of the art before March 22, 2012 in networked multimedia systems, videoconferencing, graphical interfaces for networked collaboration, interactive multimedia systems, content sharing, client/server and peer-to-peer content delivery, and software systems for displaying and controlling multimedia content across networked devices. The '464 Patent concerns a communication device for video conferencing that controls the display of captured video images and shared content across multiple display devices—subjects that fall squarely within my expertise. My education, research, and professional experience provide me with a thorough understanding of the technology at issue in this proceeding, and I am well qualified to opine on the level of ordinary skill in the art and the prior art relevant to the '464 Patent.

C. Compensation and Prior Testimony

15. I am being compensated at my standard hourly rate for my study and testimony in this matter. My compensation is not contingent on the outcome of this proceeding or the specifics of my testimony. I have previously provided expert testimony in matters involving patents related to computer systems, networking, multimedia systems, and related technologies, including depositions and trial testimony in federal court. A complete list of cases in which I have testified as an expert within the past four years is set forth in my CV, attached as Appendix A.

D. Information Considered

16. My opinions are based on my years of education, research, and experience, as well as my investigation and study of relevant materials. In forming my opinions, I have considered the materials I identify in this report and those listed in the Exhibit List at the start of this declaration.

17. I may rely upon these materials and/or additional materials to respond to arguments raised by the Patent Owner. I may also consider additional documents and information in forming any necessary opinions—including documents that may not yet have been provided to me.

18. My analysis of the materials produced in this matter is ongoing and I will continue to review any new materials as they are provided. This declaration represents only those opinions I have formed to date.

II. LEGAL STANDARDS FOR PATENTABILITY

19. In expressing my opinions and considering the subject matter of the claims of the '464 Patent, I am relying upon certain basic legal principles that have been explained to me. I understand that in an inter partes review, the petitioner bears the burden of proving unpatentability by a preponderance of the evidence. A preponderance of the evidence means that a proposition is more likely true than not true. I have applied this standard in forming my opinions in this Declaration.

20. I understand that claims subject to inter partes review are given their ordinary and customary meaning as understood by one of ordinary skill in the art in view of the patent specification and its prosecution history.

21. I understand that a prior art reference anticipates a patent claim under 35 U.S.C. § 102 if it discloses each and every element of the claim, either expressly or inherently, arranged as in the claim. Anticipation requires that the identical invention be described in a single prior art reference.

22. I understand that a claim is unpatentable as obvious under 35 U.S.C. § 103 if the differences between the claimed invention 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 at the time the invention was made. The factual inquiries underlying the obviousness determination include: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims at issue; (3) the level of ordinary

skill in the pertinent art; and (4) objective indicia of nonobviousness, such as commercial success, long-felt but unsolved needs, failure of others, and unexpected results.

23. I understand that the obviousness analysis cannot be confined by a rigid requirement of a teaching, suggestion, or motivation to combine prior art references. Any motivation known to a person of ordinary skill in the art—including common sense, the nature of the problem to be solved, or market demand—is sufficient to explain why prior art references would have been combined. The analysis must be expansive and flexible, taking into account the interrelated teachings of multiple patents, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person of ordinary skill in the art. Prior art is not limited to solving the same problem addressed by the patentee; any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining prior art elements.

24. I understand that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. If a technique has been used to improve one device, and a person of ordinary skill would recognize that it would improve similar devices in the same way, using that technique is obvious unless its actual application is beyond that person's skill. When there is a design need or market pressure to solve a problem and there are a

finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

25. I understand that a reference does not “teach away” from a combination simply because it suggests another embodiment is preferred. Teaching away requires a clear statement that the combination should not be attempted or will not work. I further understand that obviousness does not require bodily incorporation of features of one reference into another; the test is what the combined teachings of the prior art would have suggested to a person of ordinary skill. A person of ordinary skill is also a person of ordinary creativity, not an automaton.

26. I understand that obviousness must be assessed from the perspective of a person of ordinary skill in the art at the time of the invention, without the benefit of hindsight derived from the patent itself. Objective factors such as commercial success, long-felt but unsolved needs, failure of others, copying, licensing, and unexpected results may be considered as secondary indicia bearing on the question of obviousness.

27. I have applied these legal standards in my evaluation of the claims of the '464 Patent as set forth in this Declaration.

III. TECHNOLOGY BACKGROUND

28. The '464 patent generally relates to a communication device for video conferencing that controls the display of captured video images and shared content across multiple displays so that one display shows images captured by local and remote devices, and another display shows an image that is received from, and displayed by, a remote device. Every aspect of the technology described in the '464 patent was well known years before any possible priority date of March 22, 2012.

A. Sharing Content During Videoconferences Was Well Known

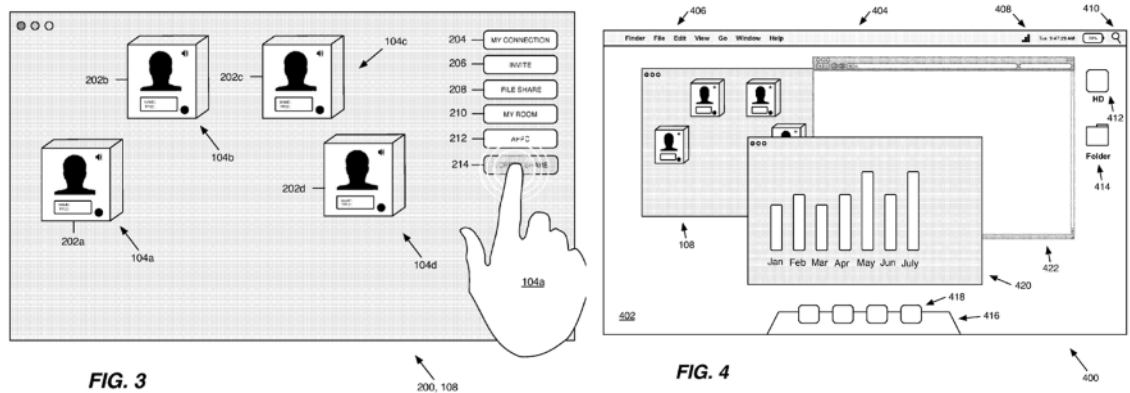
29. Sharing documents, computer screens, and presentation materials (e.g., “screen sharing”) during videoconferences was also thoroughly documented in the prior art long before the '464 patent’s priority date.

30. Nimri (EX1005) (U.S. Patent No. 5,990,931, issued November 23, 1999) discloses videoconferencing where “[a] first monitor (left monitor) 11 displays a video picture of the far scene (the remote conference site), as captured by a camera at that location” and “[a] second monitor (right monitor) 13 displays ‘still frame images’, such as a computer screen or document.” EX1005, 2:57-61. Nimri also explains that “[a] video conference may include supporting materials other than documents,” including “a computer screen display” transmitted “to a larger on-site monitor for audience viewing or to an off-site monitor,” and that “most video

videoconferencing systems have at least one means for presenting supporting materials.” EX1005, 1:34-55.

31. Watson (EX1004) (GB 2473463 A, published March 16, 2011) also discloses a system in which “two visual display units 58, 60 are provided, of which the first 58 presents video conferencing facilities and the second 60 provides shared document viewing facilities.” EX1004, p. 6. Watson’s system enables sharing of electronic documents, transmitting them as rendered bitmaps over a network to “connected parties.” EX1004, pp. 9-10, Fig. 4.

32. Jones (EX1007) (U.S. Patent Application Publication No. 2011/0271211, published November 3, 2011) discloses a system where a “participant view” shows conference participants and a “screen sharing view” in which content from one participant’s screen is presented on other participants’ displays, allowing participants to choose either view to display. EX1007, ¶¶0024, 0029-0030, Figs. 2-4.



EX1007 Figs. 3, 4

33. Salesky (EX1008) (U.S. Patent Application Publication No. 2010/0306674, published December 2, 2010) discloses a networked desktop conferencing system where a presenter selects a display “capture rectangle” to share with remote attendees, who view the shared content in real time. EX1008, ¶¶0075-0077, Figs. 1, 7A-7B.

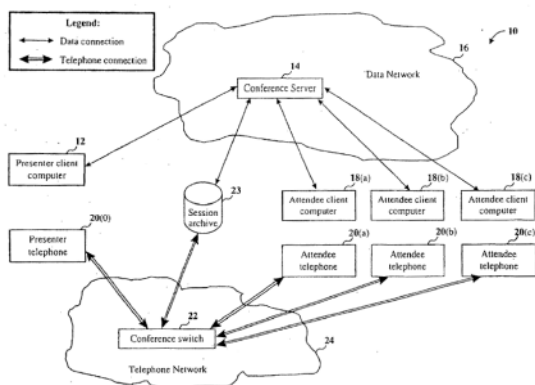


FIG. 1

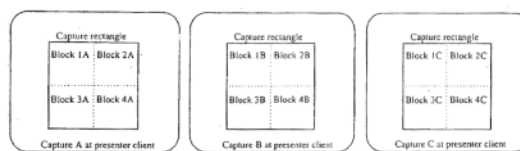


Illustration of the effect of specifying consistency at the server
(other delays in sending assumed to be caused by loading at attendee client)

Time order	Received by server	Sent by server	
		Consistency Off	Consistency On
1	Block 1A		
2	Block 2A		
3	Block 3A	Block 1A	Block 1A
4	Block 4A		
5	Block 1B		
6	Block 2B	Block 2A	Block 2A
7	Block 3B		Block 3A
8	Block 4B	Block 3B	
9	Block 1C	Block 4B	Block 4A
10		Block 1C	Block 1B
11			

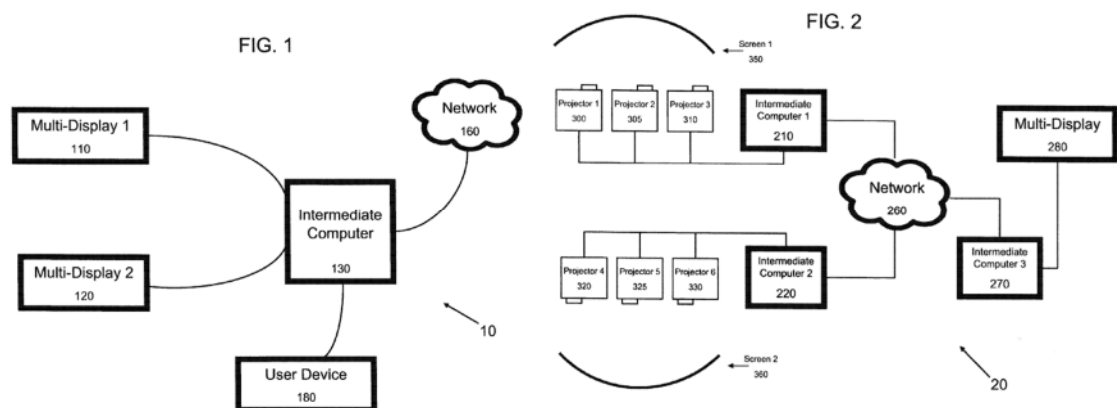
FIG. 7B

EX1008 Figs. 1, 7B

B. Dual-Monitor Displays Were Well Known

34. The use of dual-monitor displays—where a computer displays different content on different monitors—was a mature, widely deployed technology by the time of the alleged invention. Personal computers had supported simultaneous use of multiple monitors for long before 2012, beginning with native support in Windows 98 and continuing through every subsequent operating system release. Dual-monitor configurations were commonplace in video conferencing systems.

35. For example, Grover (EX1010) (U.S. Patent Application Publication No. 2012/0154256, published June 21, 2012, with priority to August 6, 2010) discloses a conference room display system where multiple displays are connected to networked computers, so that video conference participants can view visual information. EX1010, ¶¶0002-0003, 0016, 0019. Grover teaches that conference rooms may have dedicated video conferencing monitors separate from the displays showing shared data—effectively partitioning the displays so that one set handles live video of remote participants while another presents collaborative content. EX1010, ¶¶0039, 0010.



EX1010 Figs. 1, 2

36. A POSITA would have understood that managing content across multiple displays in a video conferencing system was entirely routine as of the '464 Patent priority date.

C. Assigning Different Content to Different Monitors Was Well Known

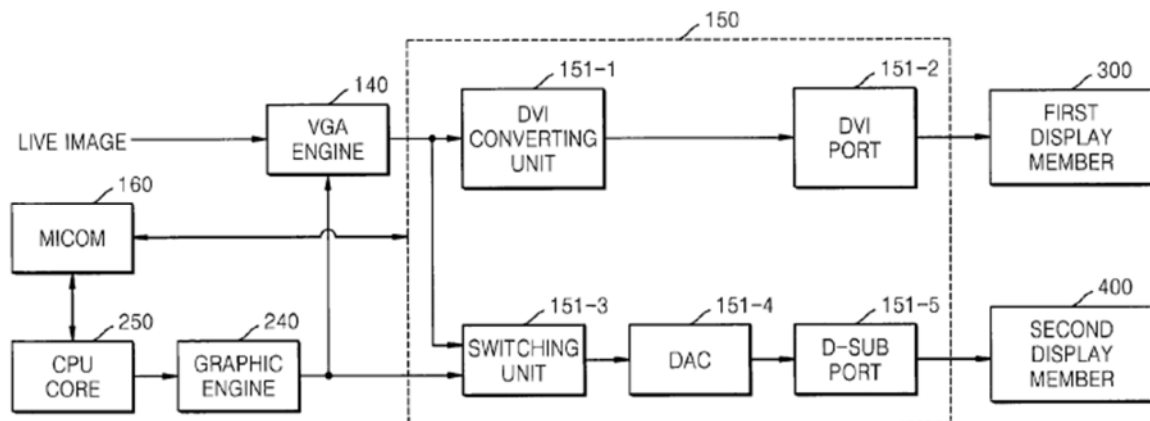
37. The idea of assigning different purposes to different monitors so that each only displays certain types of information was also known.

38. Microsoft PowerPoint's full screen presentation mode—where slides take over the entire display area of one monitor and notes and tools are displayed on another—was available years before the '464 patent's priority date. PowerPoint 2004, released in May 2004, included "Presenter Tools," which were tools visible to the presenter during a slide show. EX1011. With Presenter Tools, the presentation slides can appear on one monitor (for the audience) while the presenter sees speaker notes, slide previews, and navigation tools appear on a separate monitor. EX1011.

39. The '464 patent's claims recite that a "third image" is displayed on the second display, and this third image may comprise "an image created by using one of word-processing software, spreadsheet software, and presentation software." EX1001, Claims 3, 7. The patent specification discloses that an "image supply device" (e.g., a personal computer) supplies this image to the videoconferencing device for display on the second monitor while captured video images remain on the first monitor. EX1001, 3:33-51, 8:25-9:10. This is functionally identical to how PowerPoint Presenter View operates with two monitors: PowerPoint displays the presentation on a designated external display while the user's primary monitor shows other content such as speaker notes.

40. In Yi (EX1009) (U.S. Patent Application Publication No. 2010/0053341, published March 4, 2010) a “video presenting system having outputs for dual images” in which the system “can respectively and simultaneously output any two different images to two different display units” is disclosed. Yi further discloses that a first display member shows one image and a second display member shows a different image. EX1009, Abstract, ¶¶0003, 0005, 0008. Yi’s system sends a live image signal to one display and a document or multimedia image to the other. EX1009, ¶¶0035-0036, 0049.

FIG. 3



EX1009 Fig. 3

IV. '464 PATENT

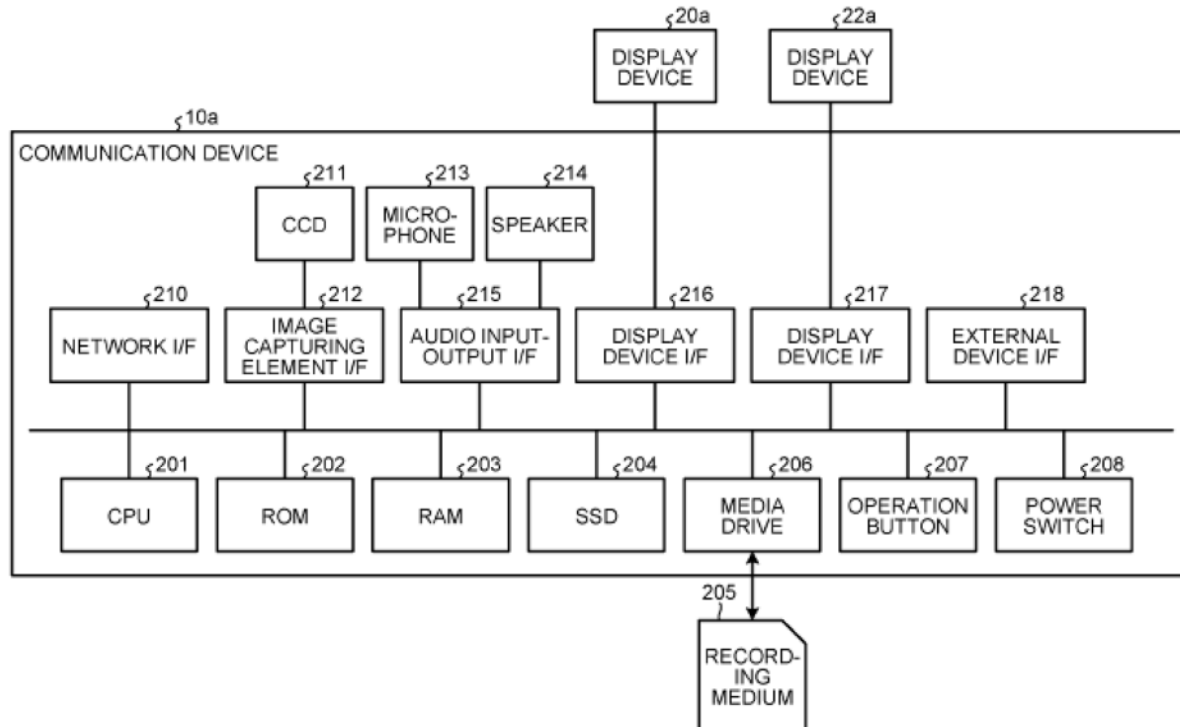
A. Overview

41. The '464 Patent discloses a communication system and device for multi-point image and audio communication, allegedly improving the visibility and usability of displayed content during video conferences. EX1001, 1:21-25, 49-61. The '464 Patent claims it addresses the problem that systems that present multiple streams on limited screen real estate can reduce visibility. EX1001, 1:40-43, 47-49; 12:20-22. The patent suggests controlling the displays so that captured images and shared content are presented in arrangements that allegedly enhance visibility. EX1001, Abstract, FIGs 5-9; 7:1-31.

42. In one embodiment, a first display shows captured images of the local and remote sites, and a second display shows an image supplied from an image supply device at either site (e.g., a desktop, an application's user interface, or a presentation.) EX1001, 3:33-51, FIGs 6-8.

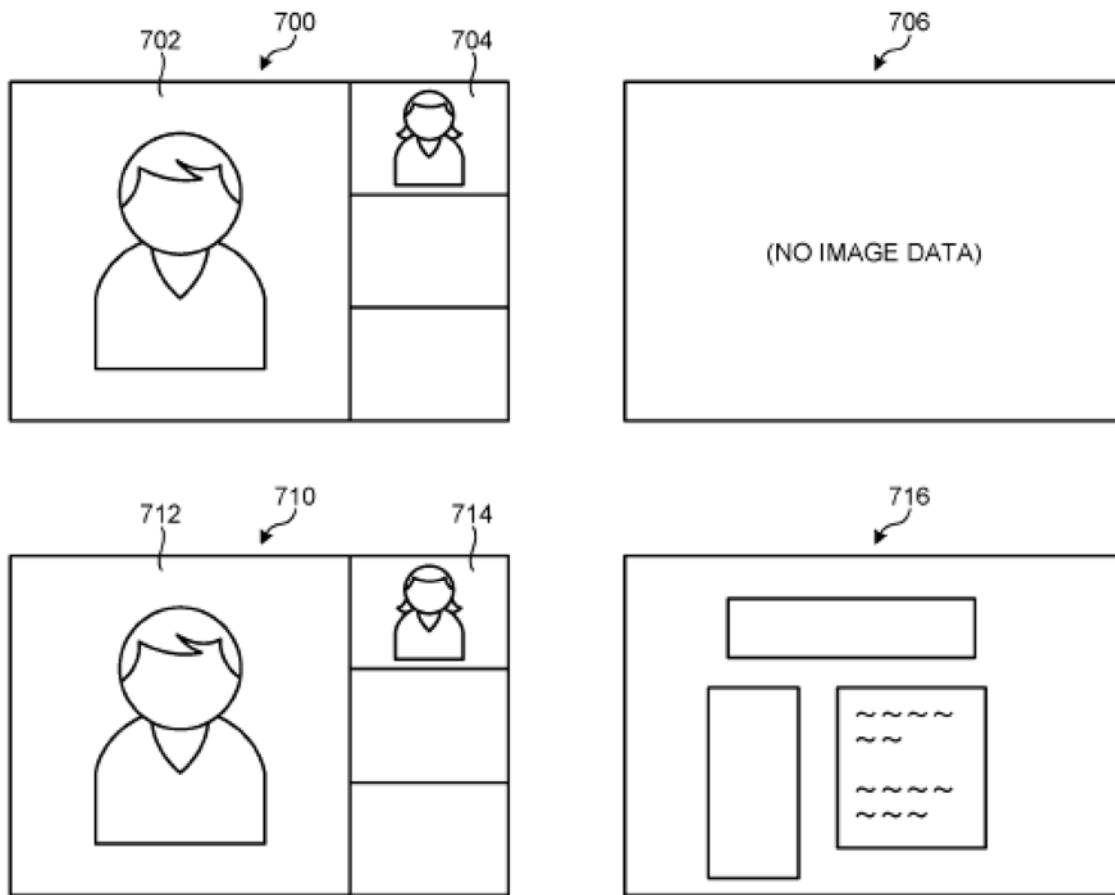
43. The communication device includes a CPU, ROM, RAM, SSD, and media drive connected via a data bus, and interfaces for networking, image capturing, audio input/output, and multiple display devices.

FIG.2



44. The '464 Patent teaches predetermined screen divisions and arrangement information tables for different connection states and modes. EX1001, 5:48-56; 7:32-11:20; FIGs 5-9. With two displays, camera feeds appear on the first display, and the shared image appears on the second. EX1001, 8:66-9:57, Figs. 6-9. The system supports switching between a camera-focused scheme (VIEW_MULTI) and a scheme that includes the shared content (SHARED_MULTI) either by user action or automatically when sharing starts or stops. EX1001, 7:52-8:11, 9:24-36. When an image supply device stops sharing on the second display, the system clears that image from the second display while maintaining the local and remote captured images on the first display. EX1001, 8:5-21.

FIG.7



B. Prosecution History

45. U.S. Patent Application No. 16/904,807 was filed on June 18, 2020, as a continuation of U.S. Patent Application No. 15/595,574, filed on May 15, 2017, which is itself a continuation of U.S. Patent Application No. 13/828,391, filed on March 14, 2013. EX1001. The application initially had nine claims. EX1002, 8-10. On August 31, 2020, the Applicant filed preliminary amendments cancelling claims 1-9 and adding claims 10-15. EX1002, 60-61.

46. In a Non-Final Office Rejection dated July 8, 2021, the Examiner rejected the pending claims under 35 U.S.C. §112(b) and interpreted certain claim language under 35 U.S.C. §112(f). EX1002, 91-94. The Examiner also rejected all pending claims as anticipated by U.S. 6,025,871 (“Kantor”) under 35 U.S.C. §102. EX1002, 94-96. On October 5, 2021, the Applicant amended claims 10-15 and added new claims 16-19. EX1002, 143-145. The amendments to claims 10-15, among other things, defined a “third image” as distinct from the first and second captured images and recited control logic for the first and second displays. EX1002, 143-145. New claims 16-19 added selectable display schemes via an operation receiving circuit (device claim 16), the corresponding method (claim 17), and a computer-readable medium implementing the same functional behavior (claims 18-19). EX1002, 145-147. In the Remarks, the Applicant contended that no new matter was introduced with claims 16-19, the pending claims did not invoke 35 U.S.C. §112(f), and that the §112(b) rejection of claims 10-15 were rendered moot by the amendments. EX1002, 150-151. The Applicant further argued that the §102 rejection was overcome because Kantor does not describe or reasonably suggest a display circuit configured to automatically control the first and second display in response to the supply of the third image being finished. EX1002, 150-154.

47. On October 22, 2021, the Examiner issued a Notice of Allowance indicating that all pending claims were allowed for the reasons set forth on pages 8-

10 of the Applicant's October 5, 2021, Remarks. EX1002, 166-170. The Examiner did not provide any additional reasons for allowance. The Notice also reflected a minor amendment to claim 16 made by the Examiner and noted that the U.S. 8,264,519 (Lunde) was considered prior art of record pertinent to the applicant's disclosure by the Examiner, but was not relied upon. EX1002, 169-170.

V. LEVEL OF ORDINARY SKILL IN THE ART

48. A person of ordinary skill in the art ("POSITA") relevant to the '464 Patent as of March 22, 2012 would have had at least: (1) a bachelor's degree in electrical engineering, computer science, computer engineering, or equivalent coursework, with at least two years of work experience in video communication systems, multi-display management, or networked multimedia applications; or (2) a master's degree in electrical engineering, computer science, computer engineering, or equivalent coursework, with coursework or research focused on video conferencing systems, display technologies, or multimedia communications. An individual with additional education could have less practical experience, and vice versa. I meet or exceed this definition of a person of ordinary skill in the art at all times relevant to this proceeding.

VI. CLAIM CONSTRUCTION

49. It is my opinion that no constructions are necessary for determining whether the prior art meets the limitations of the challenged claims.

VII. OVERVIEW OF CHALLENGE

50. It is my opinion that claims 1-10 are unpatentable, as set forth below. As set forth in this declaration, I present two grounds of invalidity: (1) Ground 1, demonstrating that Watson (EX1004) in view of Nimri (EX1005) renders obvious claims 1-10 under 35 U.S.C. §103; and (2) Ground 2A/2B, demonstrating that Weiser (EX1006) anticipates or in the alternative renders obvious claims 1-10 under 35 U.S.C. §§102/103.

51. The application that issued as the '464 patent was filed on June 18, 2020, and is a continuation of an application filed on March 14, 2013, which claims priority to a Japanese application filed on March 22, 2012.

52. The challenge is based on the references discussed below, each of which I understand to be prior art under pre-AIA 35 U.S.C. §102. None of these references were considered or cited during prosecution of the '464 Patent.

53. Watson, UK Patent Application No. GB 2473463 (EX1004) is entitled “Collaborative Working on Computer Networks” and was filed by Thales Holding UK Plc on September 10, 2009. It published on March 16, 2011, making it prior art to the '464 Patent under 35 U.S.C. §§102(a) and 102(b). Watson discloses a collaborative working environment system with two dedicated visual display units. The first presents videoconferencing facilities and the second provides shared document viewing facilities, in which electronic documents are shared by

transmitting rendered bitmap images to connected parties over a network. EX1004, p. 6, pp. 9-10, FIG.2. Watson was never cited or considered by the Examiner during prosecution of the '464 Patent.

54. Nimri, U.S. Patent No. 5,990,931 (EX1005), was filed on April 9, 1997, and issued on November 23, 1999, making it prior art to the '464 Patent under 35 U.S.C. §§102(a) and 102(b). Nimri discloses a video conferencing system with a first monitor displaying a video picture of the far conference site and a second monitor displaying still-frame images, such as a computer screen or document, that are automatically updated as the presented material changes without requiring the presenter to manually activate the update. EX1005, 2:57-61, 1:55-2:6. Nimri was never cited or considered by the Examiner during prosecution of the '464 Patent.

55. Weiser, U.S. Patent No. 8,994,778 (EX1006), was filed on December 7, 2011, and issued on March 31, 2015, making it prior art under to the '464 Patent under 35 U.S.C. §§102(a) and 102(e). Weiser discloses a computing device with a camera, multiple displays, and a video conferencing module that intercepts and mixes multiple video streams, including participant camera captures and application output content such as Microsoft PowerPoint slideshows, for display on separate monitors based on participant roles and content type. EX1006, 28:45-65, 29:22-35. Weiser was never cited or considered by the Examiner during prosecution of the '464 Patent.

56. In my opinion, Watson, Nimri, and Weiser are each relevant prior art that was overlooked during prosecution of the '464 Patent. Watson and Nimri are in the same field of endeavor, as both disclose dual-display videoconferencing systems that dedicate one display to live video and a second display to shared document or still-frame content, and Nimri's automatic detection and display-update mechanism addresses a problem left unresolved by Watson's system – namely, what happens at the receiving display when the supply of shared content ends. Weiser, in turn, independently discloses a device that mixes and dynamically remixes multiple video streams, including participant camera feeds and presentation content, for display across separate monitors based on participant role and conference state. Had the Examiner been presented with these references, I believe the outcome of prosecution would have been different.

VIII. THE ASSERTED GROUNDS OF INVALIDITY

A. Ground 1: Watson in View of Nimri Renders Obvious Claims 1-10

57. It is my opinion that Watson, in view of Nimri, renders obvious every limitation of Claims 1-10 of the '464 patent. Watson discloses a dual-display architecture (VDU 1 permanently dedicated to video conferencing, VDU 2 permanently dedicated to shared documents) and the display control circuit (CWE master 54 and CWE slave 56).

58. A POSITA would have known that when the presentation of content is finished, there are a small and finite number of reasonable things that can be done. For example, the area that displayed the content can be rendered blank, can display the last frame of the content indefinitely (though this risks confusing users who might think that a video image has frozen), or can display a message or indication that presentation of the content is finished. Watson does not describe details of how to detect and respond to “supply of the third image being finished,” so a POSITA would be motivated to combine Watson with compatible references, in the same field of endeavor, that allow Watson to be extended to implement one of these well-understood responses.

59. Nimri provides implementation details for responding to “supply of the third image being finished” by disclosing automatic content termination detection (processor 23 detecting blank frames or new slides at Step 346, 348, 358 and 352, 356, 362) and automatic display response (no slide sent or new slide sent, video continues unaffected, camera switching handled automatically). EX1005, FIG. 3B.

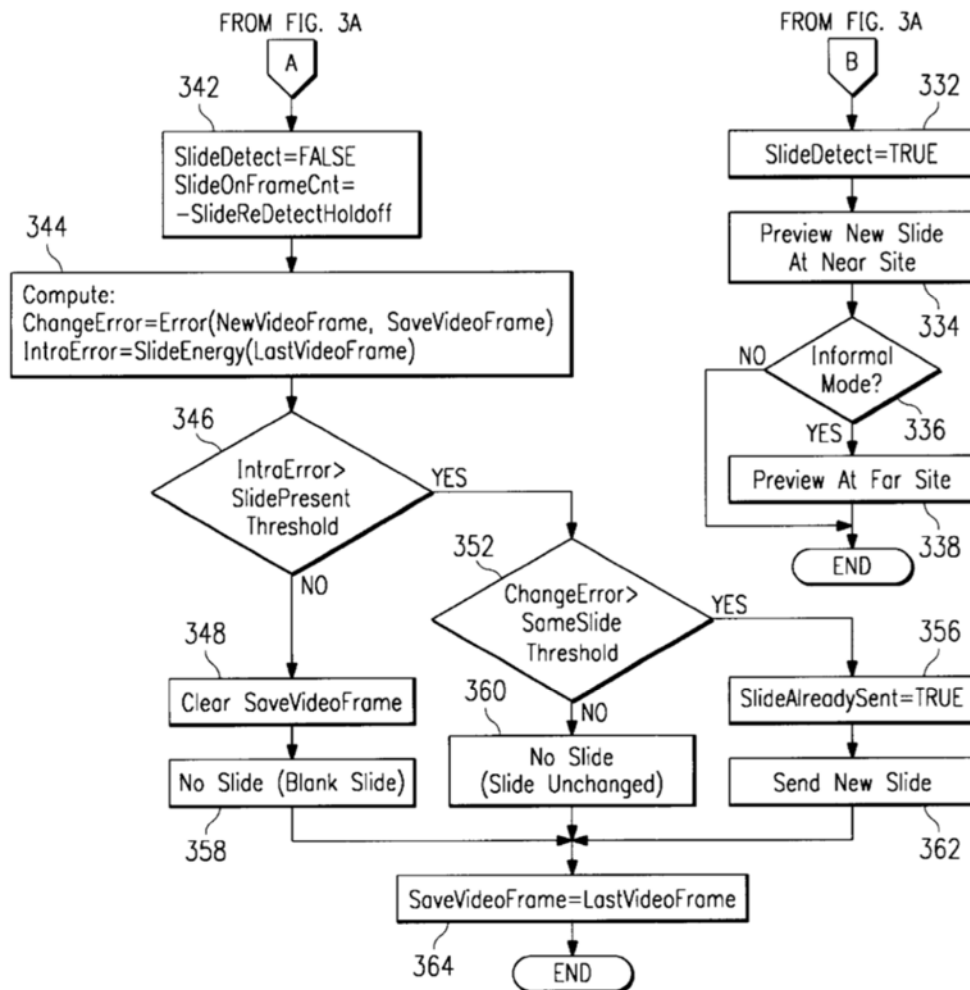


FIG. 3B

60. In my opinion, as explained below, a POSITA would have been motivated to combine these references because Nimri directly solves a problem that Watson's system faces (how to implement an appropriate behavior when sharing ends so as to prevent stale content remaining on the second).

61. Nimri expressly identifies the motivation for automatic display management (avoiding unprofessional stale content/explaining what happens when

sharing ends). Both references are in the same field of endeavor, and the combination is a predictable application of known techniques to yield predictable results.

1. Watson

62. Watson's collaborative working environment system includes a communication device (workstation 50) with a camera (64), two permanently dedicated displays (Visual Display Unit ("VDU") 1 for video conferencing, VDU 2 for shared documents), an internet network connection, and a display control architecture that assigns video conferencing content exclusively to VDU 1 and shared document content exclusively to VDU 2. In view of Watson's system architecture, a POSITA would not move the video conference to VDU 2 because Watson's work pad is purpose-built for stylus-based document interaction, not video display, and a POSITA would not move shared documents to VDU 1 because the Collaborative Working Environment ("CWE") slave driving that display is architecturally separate and exclusively manages video conferencing.

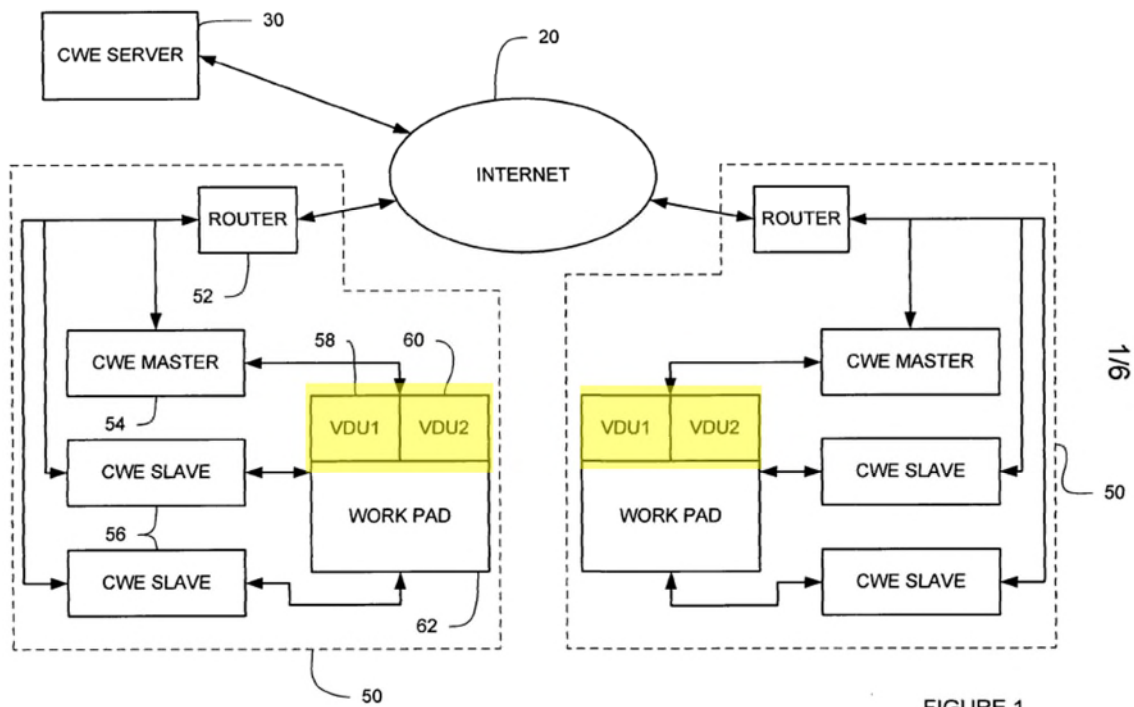


FIGURE 1

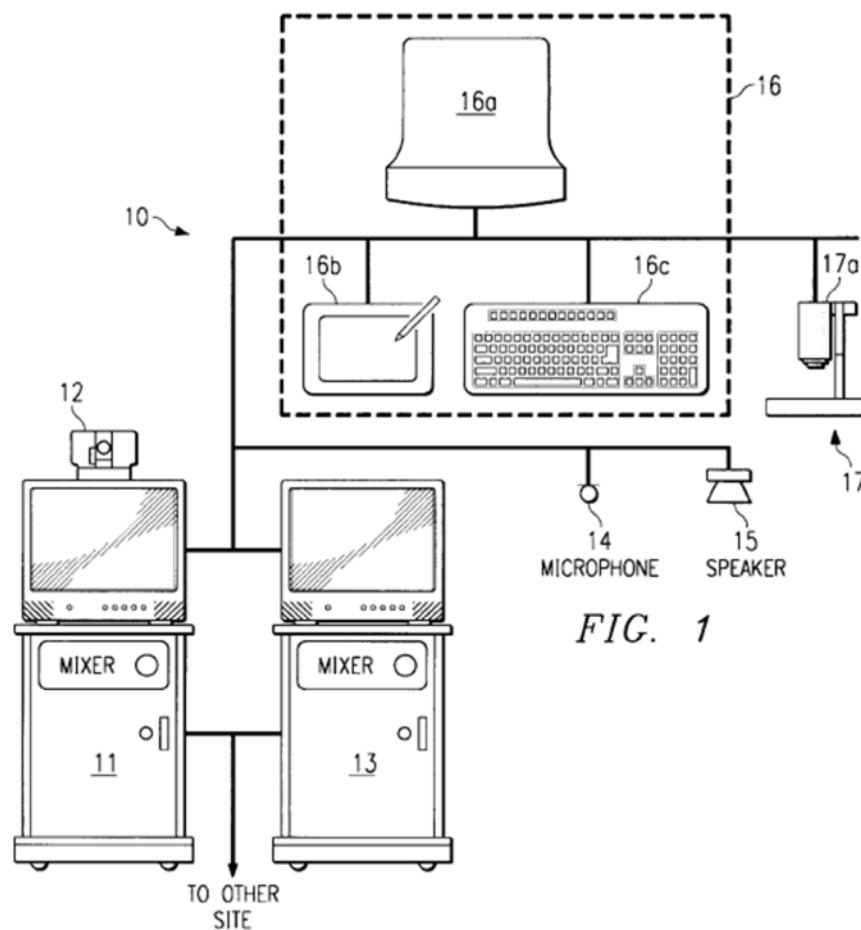
63. Claim 3/7 is satisfied because Watson discloses sharing documents created in Microsoft Word (word-processing software) and references the Microsoft Office suite, which includes spreadsheet and presentation software. Watson discloses that documents from these software applications are rendered through a universal print-to-bitmap process applicable to “any application which supports printing.”

64. Regarding claim 4/8/10, Watson discloses that the system (the CWE master, CWE slave, work pad, and pointing devices) receives user instructions to add documents to the workspace (Figure 4), and when combined with Nimri, discloses a state where VDU 2 displays no shared content (or new shared content)

and a state where VDU 2 displays the shared document image 3; in both these states, VDU 1 continuously displays the video conference.

2. Nimri

65. Nimri's videoconferencing station 10 is a communication device with camera 12, two permanently dedicated monitors (monitor 11 for live video, monitor 13 for still frame images), network communication with a remote station (similarly configured), and processor-based display control that displays video on the first display and document content on the second display. Nimri explains that a video conference may include sharing materials such as documents and "a computer screen display." EX1005, 1:34-40, 1:43-49, 3:46-50.



66. A POSITA would not move the live video conference to monitor 13 because that monitor has a dedicated purpose for presentation content, and a POSITA would not display shared content on monitor 11 because the system's processor 23 is programmed to direct shared content exclusively to monitor 13.

67. When sharing of a document is finished and it is removed from presentation, Nimri's processor detects a blank frame (Step 348) and no slide is sent. At that point, monitor 13 stops displaying the third image (because no slide is present), and it does not display the participant video (because it does not display

video). Meanwhile monitor 11 continues displaying video of the meeting participants without interruption.

68. If, instead of stopping presentation of the shared document, a new document replaces it, Nimri's processor detects this change (Step 352) and sends a new image (Step 362); this new image replaces the "finished" third image, which is no longer displayed. These transitions are automatic because Nimri's invention is directed to eliminating manual control of the slide presentation process.

3. Motivation to Combine

69. A POSITA would have been motivated to incorporate Nimri's automatic detection that a document has ceased to be shared and corresponding adjustment of the display, into Watson's similar dedicated dual-display collaborative working environment for several reasons identified below.

70. **Same Field of Endeavor:** Watson and Nimri are both directed to dual-display videoconferencing systems that show live video on a first monitor and shared document content on a second monitor, and thus share a common field of endeavor. Watson discloses "two visual display units 58, 60 ... of which the first 58 presents video conferencing facilities and the second 60 provides shared document viewing facilities." EX1004, p. 6. Nimri discloses "[a] first monitor (left monitor) 11 displays a video picture of the far scene ... A second monitor (right monitor) 13 displays 'still frame images', such as a computer screen or document." EX1005, 2:57-61. Both

systems permanently dedicate one display to video and another to shared documents. It is my opinion that a POSITA designing a dual-display videoconferencing system would have naturally looked to both references.

71. **Nimri Solves a Problem That Watson's System Faces:** Watson's system faces a usability problem: it does not disclose implementation details relating to what should be displayed on VDU 2 when the remote party stops sharing a document. Watson discloses sharing documents via bitmap tile transmission (Figure 4), but does not expressly state what happens on VDU 2 when sharing ends. Without a mechanism to detect that the document is no longer being shared and to respond by clearing or updating the display, the local workstation's VDU 2 could continue showing stale document tiles indefinitely—tiles that Watson itself acknowledges are “no longer being current.” EX1004, p. 12. **Watson leaves the particular display-management behavior for VDU 2 to ordinary implementation, and a POSITA implementing that aspect of Watson would have looked to known videoconferencing display-management techniques for predictable ways to implement control of the shared-document display.** A POSITA would have understood that there are a limited number of options of what to do with the document when sharing ends. For example, a POSITA would recognize that one option is to remove the document from the monitor when sharing of the documented has ended. Another option is to leave the document on the monitor even though the

presentation regarding that document has ended. It would have been obvious to a POSITA to remove the document from the monitor when sharing has ended, as Watson itself acknowledges the problem of tiles “no longer being current.” EX1004, p. 12. A POSITA would thus turn to another reference to fill in details of an implementation for preventing “no longer current” content from being displayed when sharing has ended.

72. Nimri’s disclosure provides these details. Nimri identifies a similar concern—the continued display of stale content after a presentation has ended. Nimri provides an implementation for preventing display of “no longer current” content: a mechanism for automatic detection of content termination (blank frame detection or new slide detection) followed by automatic display adjustment in response to no slide being sent, or a new slide being sent. EX1005, 2:6-14; 7:2-6. Nimri’s automatic detection applies both to physical documents and to “computer screen display[s]” and “computer display signal[s].” EX1005, 1:34-40; 3:46-50; 4:25-27. A POSITA would have been motivated to incorporate Nimri’s automatic detection that a document is no longer being shared into Watson to ensure that VDU 2 is automatically cleared or updated when the remote party stops sharing, rather than leaving stale tiles on the display.

73. **Nimri’s Own Motivation: Avoiding Stale Content and Maintaining Professionalism:** Nimri notes the problem that when the presenter moves on to

another subject after presenting a document, “the audience views a still slide and a video slide of the same document with no view of the presenter, which can spoil the effect of an otherwise professional presentation.” EX1005, 2:25-29. Absent some mechanism for ceasing display of stale content, this concern would apply equally to Watson’s system. In my opinion, a POSITA would have recognized that incorporating Nimri’s mechanism for automatic display clearing/updating into Watson’s system would solve this problem identified in the art, and ensure that VDU 2 shows current content when sharing is active and stops showing content when sharing of that content has ended.

74. **Predictable Combination of Known Elements:** It is my opinion that the combination of Watson and Nimri is the predictable use of known prior art elements according to known methods to yield predictable results. Watson discloses a videoconferencing system with dedicated displays (VDU 1 for video, VDU 2 for documents) and a document sharing mechanism (bitmap tile transmission and removal). Nimri teaches automatic detection of content termination (blank frame or new frame detection by processor 23) and automatic display response (ceasing to display stale content while maintaining the live video feed) for either physical documents or information being displayed on a computer. EX1005, 1:34-40; 3:46-50; 4:25-27. Incorporating Nimri’s automatic detection and response into Watson’s local workstation yields a predictable result: when the remote party stops sharing

documents, the local workstation's processor automatically detects that the document is no longer being shared, or has been replaced by a different document, and automatically updates VDU 2, while VDU 1 continues showing the video conference.

75. Using a Known Technique to Improve a Similar Device in the Same

Way: It is also my opinion that the combination uses a known technique (Nimri's automatic blank-frame/new slide detection and display updating) to improve a similar device (Watson's dual-display collaborative working environment) in the same way (automatically managing the second display when shared content is no longer available).

76. In my opinion, a POSITA would have had a reasonable expectation of success because Watson's system already monitors the shared workspace by periodically generating rendered image data and determining differences using "a bitwise logical XOR operation." EX1004, Claims 10-13. Importantly, Nimri's processor 23 is not limited to document stand camera signals but receives "a computer display signal, i.e., a VGA signal" (EX1005, 4:25-27), and Nimri's FIGS. 3-4 process is enhanced "for presenting computer screens." (EX1005, 7:56-63).

77. Nimri also determines differences, using a subtraction operation that is mathematically equivalent to XOR. (XOR is a Boolean operation that produces the difference between two binary digits). EX1005, 5:33-49. Nimri determines whether

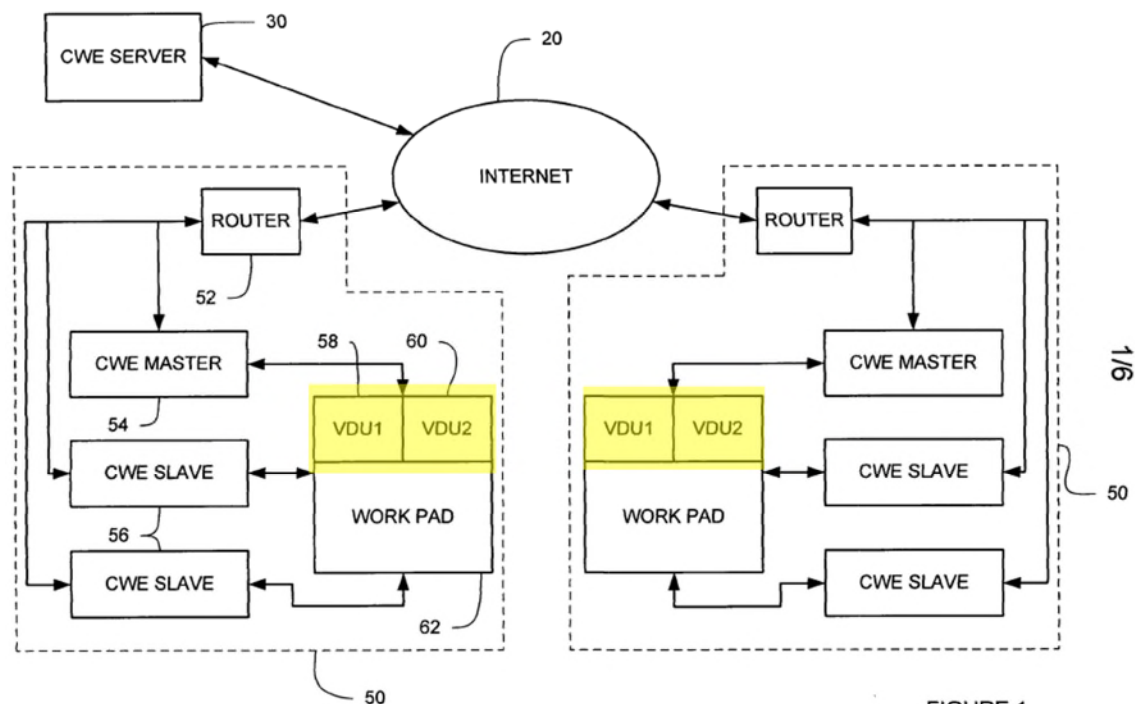
the differences exceed a “SameSlide Threshold,” (Step 352) and if so, determines that the document corresponding to the third image has been replaced, and sends a new slide corresponding to that new document. (Step 362). This results in the third image being removed from the recipient’s monitor and replaced with a new image corresponding to the new document. EX1005, 3:56-58, 7:10-16, Fig. 3B.

78. A POSITA would also have understood that while Nimri proposes a contrast-detection algorithm to detect when a document to be shared has been removed, instead of replaced, that Nimri’s algorithm to detect document replacement would also be useful for detecting that the document has been removed, so long as the SameSlide Threshold is set accordingly. In the alternative, incorporating Nimri’s contrast detection algorithm into Watson would have been a straightforward task for a POSITA, just as adapting Watson’s periodic monitoring mechanism to incorporate Nimri’s approach—detecting when the number of changes (which Watson already detects) exceeds a threshold indicating that the document has been replaced—would have been a straightforward software modification well within ordinary skill.

4. [Claim 1.pre] “A communication device”

79. It is my opinion that Watson in view of Nimri renders obvious “[a] communication device connected to an image capturing apparatus, a first display, and a second display, the communication device comprising.”

80. To the extent the preamble is limiting, Watson discloses it. Watson describes a workstation 50 which is a communication device. EX1004, p. 6, Figs. 1-2. The workstation 50 includes a CWE master 54 and CWE slave computers 56, which collectively function as a single communication device that accesses the internet by means of a router 52. EX1004, pp. 6-7. Watson recites “if a single computer can be provided with such capabilities, there is no obstacle in the present embodiment to such an implementation.” EX1004, p. 6. A POSITA would have understood Watson’s workstation 50 to be a single communication device, whether it is implemented using multiple computing units or a single combined unit.



81. Watson’s workstation 50 is connected to a camera 64 that captures video of the local user. Watson states: “A camera 64, detecting a view of the user of

the workstation 50 feeds back a signal to the computing devices 54, 56.” EX1004, p. 8. Camera 64 is an “image capturing apparatus.”

82. Watson’s workstation 50 is connected to two “visual display units”: “two visual display units 58, 60 are provided, of which the first 58 presents video conferencing facilities and the second 60 provides shared document viewing facilities.” EX1004, p. 6. VDU 1 (element 58) is a “conventional unit, such as a flat screen monitor.” EX1004, p. 7. VDU 2 (element 60) “comprises a projector which projects an image onto an electrostatic work pad 62 which defines a large drawing board style surface suitable for the formation of an image thereon or viewing by a user.” EX1004, p. 7. VDU 1 is the “first display” and VDU 2 is the “second display” of Claim 1.

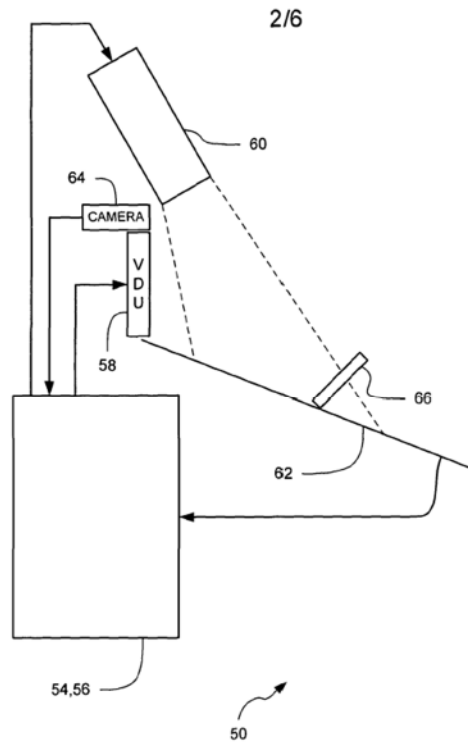


FIGURE 2

83. Watson thus discloses a communication device (workstation 50) connected to an image capturing apparatus (camera 64), a first display (VDU 1, element 58), and a second display (VDU 2, element 60). EX1004, pp. 6-8, Figs. 1-2.

84. Therefore, in my opinion, Watson in view of Nimri renders obvious “[a] communication device connected to an image capturing apparatus, a first display, and a second display, the communication device comprising.”

a) [Claim 5.pre] “A method”

85. It is my opinion that Watson in view of Nimri renders obvious “[a] method implemented by a communication device connected to an image capturing apparatus, a first display, and a second display, the method comprising.”

86. Watson discloses a method implemented by its workstation 50 (communication device). Watson’s workstation 50 is a computer-based system that executes software for the collaborative work environment and manages video conferencing. EX1004, p. 7. The CWE master 54 “executes software for the collaborative work environment, such as for the management of electronic documents shared with other users with which conferencing communication is established.” EX1004, p. 6. The CWE slave 56 “manages video conferencing.” EX1004, p. 6. When these software programs are executed by the computing devices within workstation 50, this is performing a method. A POSITA would have understood that any apparatus that performs functional operations through software execution necessarily performs a method.

87. Watson’s computing devices (CWE master 54 and CWE slave 56) perform the steps of controlling VDU 1 and VDU 2 through execution of their respective software programs. The permanent architectural dedication of VDU 1 to video conferencing and VDU 2 to shared document viewing—where video conferencing content would not be moved to VDU 2 and shared documents are not

displayed on VDU 1—is performance of the method step “controlling the first display and the second display.” EX1004, pp. 6-7. The automatic response to the third image supply being finished—in view of Nimri’s disclosure discussed below—is likewise performed as a method step by Watson’s system.

88. Therefore, in my opinion, Watson in view of Nimri renders obvious “[a] method implemented by a communication device connected to an image capturing apparatus, a first display, and a second display, the method comprising.”

b) [Claim 9.pre] “A non-transitory computer readable medium storing computer executable instructions”

89. It is my opinion that Watson in view of Nimri renders obvious “[a] non-transitory computer readable medium storing computer executable instructions which, when executed by circuitry of a computer, cause the computer to.”

90. Watson discloses a non-transitory computer readable medium. Watson’s workstation 50 comprises computer apparatus including the CWE master 54 and CWE slave computers 56 that execute software. EX1004, p. 7. The CWE master 54 “executes software for the collaborative work environment,” and the CWE slave 56 executes software that “manages video conferencing.” EX1004, p. 7. Watson thus discloses a non-transitory computer readable medium storing executable instructions that, when executed by a processor (circuitry of a computer), cause the computer to perform the described steps.

91. A POSITA would have understood that Watson's computing devices 54, 56 necessarily include non-transitory computer readable storage media (such as hard disk drives, ROM, flash memory, or other persistent storage) from which the CWE software and video conferencing software are loaded and executed.

92. The computer executable instructions stored on this non-transitory medium, when executed by the Watson's processors, in combination with Nimri, cause the computer to perform the same display control operations described in the claim: permanently dedicating VDU 1 to video conferencing and VDU 2 to shared document viewing, and automatically removing shared document tiles when the document sharing session ends.

93. Therefore, in my opinion, Watson in view of Nimri renders obvious "[a] non-transitory computer readable medium storing computer executable instructions which, when executed by circuitry of a computer, cause the computer to."

5. **[Claims 1.a/5.a/9.a] "a transceiver to transmit data of a first captured image captured by the image capturing apparatus via a network; and receive data of a second captured image via the network"**

94. It is my opinion that Watson in view of Nimri renders obvious "[a] transceiver to transmit data of a first captured image captured by the image capturing apparatus via a network; and receive data of a second captured image via the network."

95. Watson's workstation 50 streams video conferencing images over the internet. Watson recites "the camera 64 is combined with a microphone in order to allow a video conferencing stream to be established." EX1004, p. 8. The CWE slave 56 "manages video conferencing, and thus displays video conferencing images at VDU 1 (58) and associated audio, and receives respective signals from a camera and microphone." EX1004, p. 6-7. Camera 64 captures an image of the local user, which is transmitted via the internet to the remote workstation as part of the video conferencing stream. EX1004, p. 8.

96. Watson's system transmits the locally captured video image via a network. Watson describes that CWE server 30 "establish[es], when requested, conferencing communication between two user devices" over a network 10 "implemented making use of the existing infrastructure of the internet 20." EX1004, pp. 5-6. The video captured by camera 64 at the local workstation—the "first captured image"—is thus transmitted via the network to the remote workstation.

97. Watson also discloses receiving a second captured image via the network. Because Watson establishes bidirectional video conferencing between two workstations over the internet, the local workstation necessarily receives the captured video image of the remote user. EX1004, p. 6. Watson states that VDU 1 "presents video conferencing facilities," which a POSITA would understand includes displaying the received video image of the remote party. EX1004, p. 6. The

remote workstation has its own camera that captures the remote user's image and transmits it via the internet to the local workstation. EX1004, p. 8. Video conferencing, by definition, requires bidirectional transmission and reception of captured video images. The CWE slave 56 that "manages video conferencing" necessarily receives the remote user's captured image over the network and displays it on VDU 1 alongside the local user's self-view. EX1004, p. 7. This received image constitutes the "second captured image" received via the network.

98. The CWE slave 56, CWE master 54, and router 52, operating in combination, function as the claimed "transceiver" because they collectively transmit and receive image data over the internet. EX1004, pp. 6-8, Figs. 1-2.

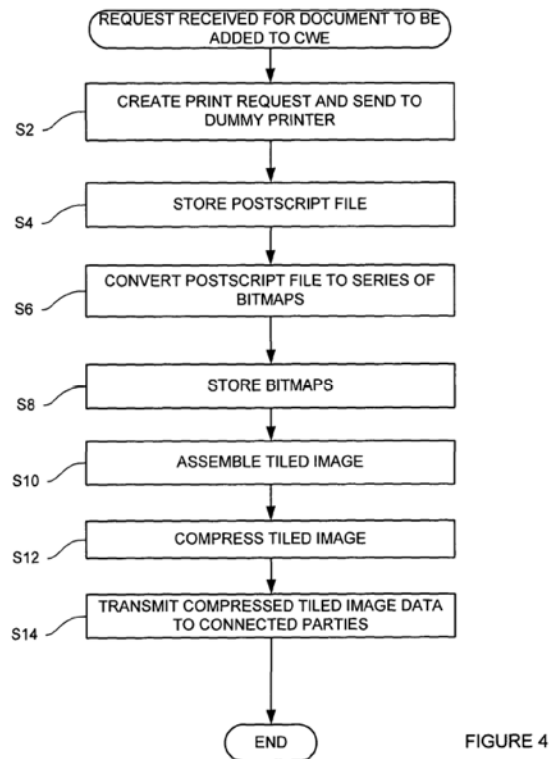
99. Therefore, in my opinion, Watson in view of Nimri renders obvious "[a] transceiver to transmit data of a first captured image captured by the image capturing apparatus via a network; and receive data of a second captured image via the network."

6. [Claims 1.b/5.b/9.b] "receive data of a third image that is displayed on a display of another communication device via the network, the third image being different than the first captured image and the second captured image"

100. It is my opinion that Watson in view of Nimri renders obvious "receive data of a third image that is displayed on a display of another communication device via the network, the third image being different than the first captured image and the second captured image."

101. In my opinion, Watson discloses this element. Watson describes a collaborative working environment in which electronic documents are shared between workstations. The CWE master 54 “executes software for the collaborative work environment, such as for the management of electronic documents shared with other users with which conferencing communication is established.” EX1004, p. 6. Watson’s system enables a computer apparatus that stores electronic documents to “render data defining an image of a workspace in a windowing graphical user interface, and to offer said rendered image data for downloading to further computer apparatus.” EX1004, Abstract, Claim 1.

102. The process of sharing a document is described in Watson’s Figure 4. When a document is to be added to the CWE, the hosting workstation creates a print request, sends it to a dummy printer driver, converts the document into a postscript file, renders the postscript file as a series of bitmaps, assembles and compresses a tiled image, and finally “transmit[s] compressed tiled image data to connected parties.” EX1004, p. 9, Fig. 4, Steps S2-S14.



103. This shared document image is displayed on the workspace of the remote workstation (VDU 2) before being transmitted. Watson states: “a tile 72 represents a view of a document, such as can be opened by the Microsoft Word™ application.” EX1004, p. 8. The shared document image is the “third image” that is “displayed on a display of another communication device.” It is rendered and displayed on the workspace of the remote workstation before being transmitted via the network to the local workstation. EX1004, pp. 8-10, Fig. 4.

104. Watson also discloses that the third image is “different than the first captured image and the second captured image.” The shared document image is a

bitmap rendering of a document file—such as a Microsoft Word document—not a video capture from any camera. EX1004, p. 9 (converting postscript file to bitmaps).

105. Watson also discloses that the system “periodically generate[s] said rendered image data” and transmits only the differences between successive images to connected parties. EX1004, Claims 10-13. After changes are made and transmitted, “display updates are then transmitted back to the other connected parties to ensure that the image at the shared application is synchronised at all connected parties.” EX1004, p. 11. A POSITA would thus have understood that the third image data is continuously updated via the network.

106. Therefore, in my opinion, Watson in view of Nimri renders obvious “receive data of a third image that is displayed on a display of another communication device via the network, the third image being different than the first captured image and the second captured image.”

7. **[Claims 1.c/5.c/9.c] “a display control circuit configured to control the first display and the second display; and in response to supply of the third image being finished while the first display displays the first captured image and the second captured image and the second display displays the third image, automatically control the first display to display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image”**

107. It is my opinion that Watson in view of Nimri renders obvious “a display control circuit configured to control the first display and the second display; and in response to supply of the third image being finished while the first display

displays the first captured image and the second captured image and the second display displays the third image, automatically control the first display to display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image.”

108. The limitation requires that when the supply of image 3 is finished, image 3 is removed from display B, and the images 1 and 2 remain where they already are—on display A. The concept of removing an image when the device that is sharing it is “finished” is not a novel concept, nor is the idea of leaving images on the monitor where they are already being displayed. In fact, a POSITA would have known that removing content when sharing of it has stopped is one of only a few appropriate behaviors, and that the same applies to leaving the other images where they are.

109. **Display Control Circuit:** Watson’s CWE master 54 and CWE slave 56, if modified to incorporate Nimri’s processor-based automatic detection logic, results in the “display control circuit configured to control the first display and the second display.” EX1004, p. 7. The CWE slave controls VDU 1 for video conferencing, and the CWE master controls VDU 2 for shared documents. In the combined system, the CWE master further incorporates Nimri’s change detection (Steps 352, 356, 362), and can also incorporate Nimri’s processor 23 blank-frame

detection (Steps 346-348), to monitor whether the shared material has been removed or replaced, and to automatically clear VDU 2, or to replace the image on VDU 2, when it has. EX1005, 7:2-6.

110. **“In Response to Supply of the Third Image Being Finished”:** In the combined system, the supply of the third image is “finished” when the remote workstation stops transmitting shared data corresponding to a particular document—for example, when the remote party stops sharing, disconnects from the collaborative workspace or replaces the document to be shared. At that point, the local workstation’s modified CWE master detects the absence of incoming shared content or a change in shared content, using Nimri’s automatic detection principle. Nimri’s system processor 23 performs this detection.

111. Nimri discloses two different mechanisms where the supply of the third image finishes, and in each case the result is that the third image is no longer displayed on the second monitor of videoconference participants.

112. In the first mechanism, Nimri’s system detects that a new “slide” has replaced the slide corresponding to the third image (Step 352), and sends a new image to replace the third image (Step 362). To do this, a ChangeError is computed (Step 344). ChangeError is computed by, for each pixel, subtracting its value at a

later point in time from its value at an earlier point in time.¹ EX1005, 5:40. This calculation is similar to the way Watson identifies differences between two versions of a document image by performing a bitwise logical XOR operation. A bitwise logical XOR operation, it should be noted, is the same as a bitwise subtraction operation; the results are identical. Nimri next sums the results of these subtractions over all of the pixels, and compares the sum to a SameSlide Threshold. EX1005, 5:28-43. If the sum of the changes is greater than the predefined threshold, then the system knows that a new document has been provided for display and transmission, and sends a corresponding image of the new document to the other conference participants, replacing the third image.

113. In the second mechanism, Nimri's system detects that the document to be displayed has been removed, by detecting a blank image. Nimri's system detects this blank image by comparing each pixel's value to the average value of all pixels; this is a type of contrast detection. (Step 344) If the sum of differences from the average value is less than SlidePresent Threshold (Step 346), then the system determines that nothing needs to be displayed and transmitted (Step 358) because

¹ Nimri specifically proposes encoding each pixel as its deviation from the average pixel value before performing subtractions. EX1005, 5:33-5:60. This is because, when sharing physical paper documents, lighting may fluctuate, and a change in lighting shouldn't result in sending a new image of the same document. However, a POSITA would understand that this is not necessary when sharing a computer screen instead of a physical paper document.

the image is, effectively, blank. This results in display of third image being stopped.
(Fig. 4, Stop Preview).

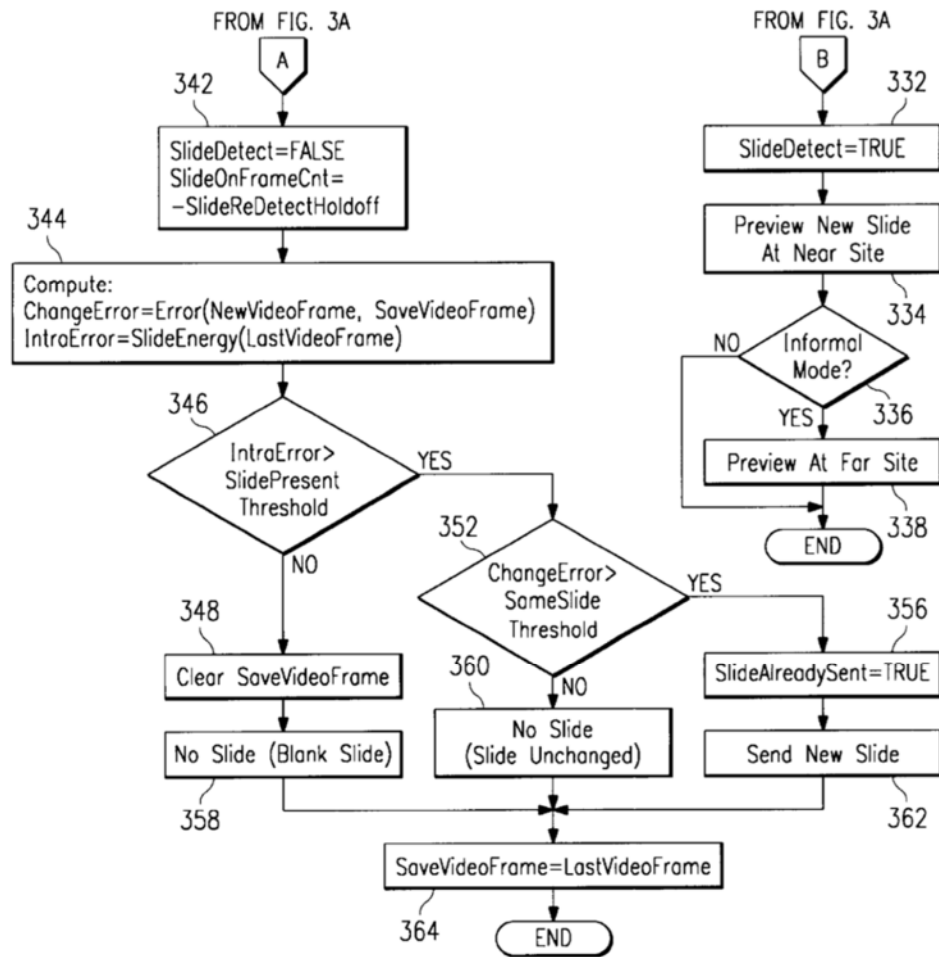


FIG. 3B

114. In the combined system, the CWE master automatically detects, with no manual intervention by the receiving workstation, that no new tile data is being received or that the workspace image has become empty. This means that the supply of the third image has ended.

115. “While the First Display Displays the First Captured Image and the Second Captured Image and the Second Display Displays the Third Image”:

This limitation is met by the proposed combination because, up until the point where the third image supply is ended, the system is in Watson’s normal operating state: VDU 1 is displaying the video conference (first and second captured images) and VDU 2 is displaying the shared document tile (the third image). EX1004, p. 6. This is a consequence of Watson’s dedicated display architecture, in which each display has an assigned purpose.

116. “Automatically Control the First Display to Display the First Captured Image and the Second Captured Image”: In the proposed combination, VDU 1 continues displaying the video conference without interruption. VDU 1 is dedicated to video conferencing regardless of the presence or absence of shared documents on VDU 2. EX1004, p. 6; p. 7. The CWE slave 56 continues managing video conferencing on VDU 1 regardless of what happens on VDU 2. Nimri reinforces this principle, because in Nimri’s system monitor 11 continues displaying the far-scene video, unaffected by the termination of the still frame presentation on monitor 13. EX1005, 2:7-12, 2:57-3:5.

117. “Control the Second Display to Display None of the First Captured Image, the Second Captured Image, and the Third Image”: In the proposed combination, when the modified CWE master detects (per Nimri’s automatic

detection techniques) that shared content is no longer being supplied or the supplied content has changed, VDU 2 is automatically cleared (the existing image is removed) or updated to reflect the new content (the existing image is removed, and a new document image takes its place). In either case, it does not display the “third image” (it displays no image if the document has simply been removed, or displays a completely new “fourth image” if the document has been replaced). Nor does it display video conferencing images (because VDU 2 does not display video under Watson’s dedicated architecture—there is no mechanism that allows for routing the CWE slave’s video output to VDU 2). EX1004, pp. 7-8. The result is that VDU 2 displays “none of the first captured image, the second captured image, and the third image.”

118. A POSITA would have understood this result is obvious from Nimri’s disclosure. When Nimri’s processor 23 detects a blank frame and “No slide is sent” (Step 348), monitor 13 has no content to display—neither video (as it does not show video) nor a document image (since it is no longer being provided). EX1005, 7:5-8. The same applies when Nimri’s processor detects a new slide (steps 352, 362). In this case the image which had been displayed on VDU 2 is removed, and replaced by a new image corresponding to a new document. In the proposed combined system, when VDU 2’s content supply has ended and the automatic detection logic recognizes this, VDU 2 displays nothing. Watson’s architectural separation ensures

that VDU 2 cannot fall back to displaying video—it can only display shared workspace content, and when that content is absent, VDU 2 shows nothing at all.

119. **Reasonable Expectation of Success:** A POSITA would have had a reasonable expectation of success in combining Watson and Nimri to achieve the claimed automatic display control. Watson provides a periodic workspace monitoring mechanism through which the system generates rendered image data and detects differences between successive versions using “a bitwise logical XOR operation.” EX1004, Claims 10-13. This existing mechanism provides the infrastructure for detecting changes in the workspace—including the change from “shared content present” to “shared content absent.” Incorporating Nimri’s blank-detection approach—calculating the “energy” of the image by comparing pixel values to the average pixel value, summing the differences, and comparing to a threshold—would have been a straightforward software adaptation. EX1005, 7:2-6. Both systems already employ techniques where two images are compared to evaluate differences, and extending Watson’s comparison to recognize the specific condition of “no content remaining” is a trivial modification.

120. Furthermore, both Watson and Nimri are implemented in software running on general-purpose computers. Watson’s CWE master 54 and slaves 56 are computers executing collaborative workspace software. EX1004, p. 7. Nimri’s computer 16a is “a PC-type general purpose computer” with processor 23 executing

programmed logic. EX1005, 3:17-25. The software-based architecture of both systems allows for incorporating Nimri's automatic detection logic into Watson's CWE master merely by adding threshold comparison logic to the existing image monitoring software, and requires no hardware redesign.

121. Therefore, in my opinion, Watson in view of Nimri renders obvious "a display control circuit configured to control the first display and the second display; and in response to supply of the third image being finished while the first display displays the first captured image and the second captured image and the second display displays the third image, automatically control the first display to display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image."

8. [Claims 2/6] "wherein the third image comprises one of a desktop screen and a user interface of an application program"

122. It is my opinion that Watson, in view of Nimri, renders obvious "wherein the third image comprises one of a desktop screen and a user interface of an application program."

123. Watson, in view of Nimri, discloses this element. Watson describes that "a tile 72 represents a view of a document, such as can be opened by the Microsoft Word application. A portion of another tile 74 is also illustrated. An arrow pointer 76 is also illustrated, which reflects use of a pointing device 66. The reader will

appreciate that, in an embodiment where several users are participating in use of a single workspace, an arrow pointer will be displayed per user using a pointer device.” EX1004, p. 8.

124. Nimri teaches that the still frame images shared and displayed on the second monitor may comprise “a computer screen display.” EX1005, 1:34-40, 1:43-49, 3:46-50. Nimri states: “it may be desirable to present a computer screen display by transmitting the image data from which the display is generated to a larger on-site monitor for audience viewing or to an off-site monitor.” EX1005, 1:34-38. A “computer screen display” is a “desktop screen” or a “user interface of an application program,” as it is the visual output displayed by a computer, which would be understood by a POSITA to include the desktop and/or the user interface of one or more running application programs. A POSITA would have understood that transmitting “the image data from which the display is generated” captures the entire computer screen, including whatever desktop environment or application program interface is currently displayed.

125. Nimri confirms that the still frame images encompass application program interfaces. Nimri describes enhancements “for presenting computer screens” and states that “[c]ursor movement can be ignored for purposes of determining whether to send a new slide” and that “[c]hanges that occur within a small area matching the area of the cursor icon can be ignored.” EX1005, 7:56-63.

This passage reflects that Nimri’s system includes sharing computer screen displays that include cursors, application windows, and other graphical user interface elements—the hallmarks of a “user interface of an application program.” Similarly, Nimri states that “[i]n computer screen presentations, a significant change may be one that is not merely a movement of the cursor or of some other non-substantive object.” EX1005, 7:37-39. The reference to “non-substantive objects” like cursors and timer icons demonstrates that Nimri contemplates sharing images of full application program user interfaces, in which cursors and hourglass icons are standard UI elements.

126. In fact, Nimri’s Claim 4 recites that “said frames represent displays on a computer screen and wherein said significance criterium is based on a change to a predetermined object in said displays.” EX1005, Claim 4. This confirms that the “still frame images” transmitted and displayed on monitor 13 include computer screen displays—which may constitute either a “desktop screen” or “a user interface of an application program.”

127. Therefore, in my opinion, Watson in view of Nimri renders obvious “wherein the third image comprises one of a desktop screen and a user interface of an application program.”

9. [Claims 3/7] “wherein the third image comprises an image created by using one of word-processing software, spreadsheet software, and presentation software”

128. It is my opinion that Watson in view of Nimri renders obvious “wherein the third image comprises an image created by using one of word-processing software, spreadsheet software, and presentation software.”

129. Watson describes that the documents shared in its collaborative workspace are created using word-processing software. Watson states that “a tile 72 represents a view of a document, such as can be opened by the Microsoft Word™ application.” EX1004, p. 8. Microsoft Word is word-processing software. The tile 72 displayed on VDU 2 is “an image created by using one of word-processing software.” Specifically, it is a bitmap rendering of a Microsoft Word document that has been converted through Watson’s dummy printer process. EX1004, pp. 9-10, Fig. 4, Steps S2-S14.

130. Watson also confirms that its system is compatible with the full range of Microsoft Office applications. Watson states that “[p]opular document types include those used in conjunction with the Microsoft Office™ suite of products, but the invention is evidently not limited to such.” EX1004, p. 11. The Microsoft Office suite included word-processing software (Microsoft Word), spreadsheet software (Microsoft Excel), and presentation software (Microsoft PowerPoint). A POSITA would have understood Watson’s disclosure to encompass documents created in any

of these applications, because Watson's dummy printer process operates on any application that supports printing. Watson states: "This printer driver can be called up by any application which supports printing." EX1004, p. 8. Since spreadsheet and presentation software applications support printing, Watson's system would be able to produce bitmap tiles from documents created using spreadsheet software or presentation software with identical facility.

131. Therefore, in my opinion, Watson in view of Nimri renders obvious "wherein the third image comprises an image created by using one of word-processing software, spreadsheet software, and presentation software."

10. [Claims 4/8/10] "an operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme, wherein according to the first display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display none of the first captured image, the second captured image, and the third image, and according to the second display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display the third image"

132. It is my opinion that Watson in view of Nimri renders obvious "an operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme, wherein according to the first display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display none of the first captured image, the second captured image, and the third image, and

according to the second display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display the third image.”

133. Watson in view of Nimri renders obvious Claims 4/8/10 for the reasons discussed with respect to Claim 1 and as I further explain below.

134. Identifying the Two Display Schemes in the Combined System: Claim 4 requires the ability to change between two display schemes. In the combined Watson/Nimri system, these two states correspond to: (1) a state in which the video conference is active on VDU 1 but image 3 is not being shared on VDU 2 (VDU 1 shows video; VDU 2 does not show image 3); and (2) a state in which both the video conference is active on VDU 1 and a shared document tile is displayed on VDU 2 (VDU 1 shows video; VDU 2 shows the document tile).

135. Watson’s Disclosure of User-Initiated Transitions Between Schemes: Watson discloses mechanisms by which a user initiates document sharing—transitioning from the first display scheme to the second. Watson explains that Figure 4’s process “commences on receipt of a request for a document to be added to the CWE.” EX1004, p. 8, Fig. 4. This request is generated by user input: “in a Microsoft Windows environment, a right click of a pointing device (such as a mouse) when the pointing device icon is over a document icon, causes display of a menu which, in most cases, includes a print option.” EX1004, p. 8. The user’s action

of requesting a document to be added to the CWE constitutes or generates an instruction that transitions the system from the first display scheme (no shared documents on VDU 2) to the second display scheme (shared document tile displayed on VDU 2).

136. **Watson further discloses user-initiated transitions in the opposite direction:** Watson's Figure 6 begins when a user closes a shared application (step S31). EX1004, p. 13, Fig. 6. However, as explained in my analysis for element [1.c], Watson does not disclose the automatic display control that removes the third image from VDU 2 when document sharing of the third image ends. This is disclosed in Nimri, however.

137. **Nimri's Contribution to the Transition from Second to First Scheme:** Nimri supplies the automatic detection and display control that completes the transition from the second display scheme back to the first. EX1005, 1:34-40; 3:46-50. In the proposed combined system, when the remote workstation stops sharing documents (or the user closes the shared application), the local workstation's CWE master, incorporating Nimri's automatic detection logic, detects the absence of incoming shared content. Nimri teaches that processor 23 detects blank frames by comparing using a contrast detection method. Nimri teaches a second mechanism, for detecting changes in documents, that a POSITA would also detect a blank frame (assuming that the "SameSlide Threshold" is appropriately set.) EX1005, 5:33-49.

Using either of Nimri's methods, when a blank frame is detected, in the combined system, this automatic detection triggers the removal of the third image of VDU 2—completing the transition from the second display scheme (shared content on VDU 2) to the first display scheme (nothing on VDU 2).

138. **The “Operation Receiving Circuit” in the Combined System:** Watson's CWE master 54 and CWE slave computers 56, together with the associated input devices, are an “operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme.” Watson discloses that the user opens shared documents “by performing a selection operation, either on a button 78 as illustrated or by ‘double tapping’ ... in the field of the tile 72.” EX1004, p. 11. Watson's Claim 7 further confirms that the system receives “a user input action comprising a keystroke on a keyboard, or an input action on a pointing device such as a mouse or touchpad.” EX1004, Claim 7.

139. The CWE master 54 receives these user inputs and determines whether to add or remove documents from the shared workspace. When a user requests adding a document (EX1004, Fig. 4), the CWE master processes this request and transitions the system to the second display scheme. When a user closes a shared application (EX1004, Fig. 6, Step S31), the CWE master, modified to incorporate Nimri's automatic detection logic, responds to this event by transitioning the system back to the first display scheme, and updating VDU 2. EX1004, pp. 9, 13, Figs. 4,

6. The computing devices that receive and process these user inputs are the claimed “operation receiving circuit.”

140. **The combined Watson/Nimri system satisfies the “first display scheme” requirement:** In the first display scheme (no sharing of a third “document” image document), VDU 1 displays the video conference (the local and remote users’ camera images, which are the “first image” and “second image”)—because VDU 1 is dedicated to video conferencing. EX1004, p. 6; p. 7. VDU 2 displays “none of the first captured image, the second captured image, and the third image”: the third image (the document) is not present on VDU 2 (because the third document is no longer being shared), and no video conferencing images appear on VDU 2 (because Watson’s dedicated architecture does not permit VDU 2 to display videoconference images). EX1004, p. 7-8.

141. Nimri’s disclosure is consistent with this result. In Nimri’s system, when no still frame image is being sent (because processor 23 detected a blank frame and cleared SaveVideoFrame at Step 348), monitor 13 displays neither video (which it does not show under Nimri’s dedicated architecture) nor a still frame (which is no longer being provided). EX1005, 7:2-6; 3:1-6. The combined system achieves the identical result: VDU 2 shows no content of any kind while VDU 1 continues showing the video conference.

142. **The combined Watson/Nimri system satisfies the “second display scheme” requirement:** In the second display scheme (where a document image is shared), VDU 1 continues to display the video conference (first and second captured images), because VDU 1 is dedicated to video conferencing. EX1004, p. 6; p. 7. VDU 2, meanwhile, displays the shared document tile (the third image)—the bitmap rendering of the shared document transmitted from the remote workstation via Watson’s Figure 4 process. EX1004, pp. 8-10, Fig. 4.

143. In both display schemes, consistent with Watson’s disclosure, VDU 1 shows video conferencing content and VDU 2 shows either shared documents (second scheme) or nothing (first scheme).

144. **The motivation to combine Watson and Nimri for Claim 4 is the same as that set forth in Section VIII.A.3.** Additionally, switching between display schemes via an instruction is supported by the combination. Watson teaches that the user initiates sharing via a pointing device right-click or selection operation. EX1004, p. 9. Watson also teaches that the user opens shared documents “by performing a selection operation, either on a button 78 as illustrated or by ‘double tapping’ ... in the field of the tile 72.” EX1004, p. 11. These user actions, received and processed by Watson’s computing devices, constitute “instructions” to change between display schemes.

145. A POSITA would have found it obvious to implement a unified control mechanism in the combined system, such as a single button on Watson's control panel window 80 or a keyboard shortcut, to switch between displaying shared content on VDU 2 (second scheme) and showing nothing on VDU 2 (first scheme). EX1004, Fig. 3, element 80. A POSITA would have been motivated to do so to increase user convenience. A POSITA would have understood that in the context of sharing of a screen, providing controls to start or stop content sharing simplifies the user experience while collaborating with documents. A POSITA would have had a reasonable expectation of success because implementing a toggle between two predefined display states is a trivial software modification to Watson's CWE master 54, which already processes user inputs. Further, Nimri is compatible with Watson's disclosure because Nimri discloses its own input devices that could be purposed to start or stop sharing, especially in the context of screen sharing (keyboard 16c, control pad 16b). Nimri also discloses "command signals" that cause switching being schemes, and which ensure that transitioning between schemes operates in both directions. EX1005, 3:25-30; 4:28-36; 6:43-54.

146. Therefore, in my opinion, Watson in view of Nimri renders obvious "an operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme, wherein according to the first display scheme, the first display is controlled to display the first captured image and

the second captured image and the second display is controlled to display none of the first captured image, the second captured image, and the third image, and according to the second display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display the third image.”

B. Ground 2: Weiser Anticipates and in the Alternative Renders Obvious Claims 1-10

147. It is my opinion that Weiser discloses and in the alternative renders obvious every limitation of Claims 1-10. Weiser discloses a computing device with a camera, multiple displays, and a Video Conference/Ethernet module that intercepts, mixes, and manages multiple video streams transmitted over a network. Weiser discloses that video streams include both participant camera captures (first and second captured images) and application output content such as Microsoft PowerPoint slideshows and PDF documents (the “third image”). Weiser discloses providing separate mixed streams to separate displays based on participant roles and content type (FIG. 3B), with the system dynamically remixing streams “as slides or other documents are shown, as different participants take on speaker roles, or responsive to other requirements.”

148. A POSITA would have understood that a consequence of Weiser’s disclosure of role-based stream remixing is that when the presenter role shifts to a new presenter, the second display stops showing the first presenter’s shared content,

while the first display continues showing images of the meeting participants. Weiser further discloses that external video connections can be closed and video reception stopped, at which point the system necessarily would automatically exclude that stream from the mix, as it is unavailable for mixing.

149. A POSITA would also have found it obvious that when the presentation stream (third image) is finished, the first display continues showing participant camera feeds while the second display, which had been dedicated to the presentation, no longer shows the shared content. This is the natural, predictable result of Weiser's dynamic remixing architecture applied to a dual-display video conferencing system.

150. Claim 2 is disclosed by Weiser, because the reference discloses that the shared content stream comprises "an application output window," which is a user interface of an application program, and "other displayed information" that would be understood to include a desktop screen. Claim 3 is satisfied because Weiser recites "a Microsoft PowerPoint slideshow" (presentation software) as a video stream source, discloses "a PDF document" (routinely created from word-processing, spreadsheet, or presentation software), and references dynamic remixing "as slides or other documents are shown." Claim 4 is satisfied because Weiser's video conferencing application selects mixing formats from predetermined arrangements based on participant roles and conference state, dynamically remixes streams when presentations begin or end, and processes user instructions (through

I/O devices and user interfaces) to initiate or terminate content sharing. In doing so, Weiser's system transitions between a non-presentation state (first scheme) and a presentation state (second scheme).

1. [Claim 1.pre] "A communication device"

151. It is my opinion that Weiser discloses "[a] communication device connected to an image capturing apparatus, a first display, and a second display, the communication device comprising."

152. Weiser discloses computing device 102 that hosts a Video Conference/Ethernet module 100 and participates in video conferences. Weiser states that the first video stream "may comprise a first video capture of the first video conference participant from the first device, such as from a webcam, integrated camera, external USB camera, or other video capture device." EX1006, 29:56-60. The webcam, integrated camera, or external USB camera constitutes the "image capturing apparatus."

153. Weiser also discloses that computing device 102 may be connected to multiple display devices, stating "the computing device 102 may comprise or be connected to multiple I/O devices 178a-178n or one or more display devices 175." Weiser also states that "any portion of the operating system of the computing device 102 may be configured for using multiple display devices 175." EX1006, 23:55-60; 24:30-40.

154. Weiser further states that “the computing device 102 may include any type and/or form of video adapter, video card, driver, and/or library to interface, communicate, connect or otherwise use the display devices 175. In one embodiment, a video adapter may comprise multiple connectors to interface to multiple display devices 175. In other embodiments, the computing device 102 may include multiple video adapters, with each video adapter connected to one or more of the display devices 175. EX1006, 25:36-58. This establishes that Weiser’s computing device can be connected to at least a first display and a second display.

155. Moreover, Weiser discloses that mixed video streams may be provided to separate displays. Weiser states: “video streams 302A-302D may be mixed by a video mixer into a first mixed video stream 306A for display on a first display 304A. The video streams may also be mixed into a second mixed video stream 306B for display on a second display 304B.” EX1006, 28:60-29:35, FIG. 3B. A POSITA would have understood that Weiser’s computing device 102, connected to a camera and multiple display devices, constitutes a communication device connected to an image capturing apparatus, a first display, and a second display.

156. Therefore, in my opinion, Weiser discloses “[a] communication device connected to an image capturing apparatus, a first display, and a second display, the communication device comprising.”

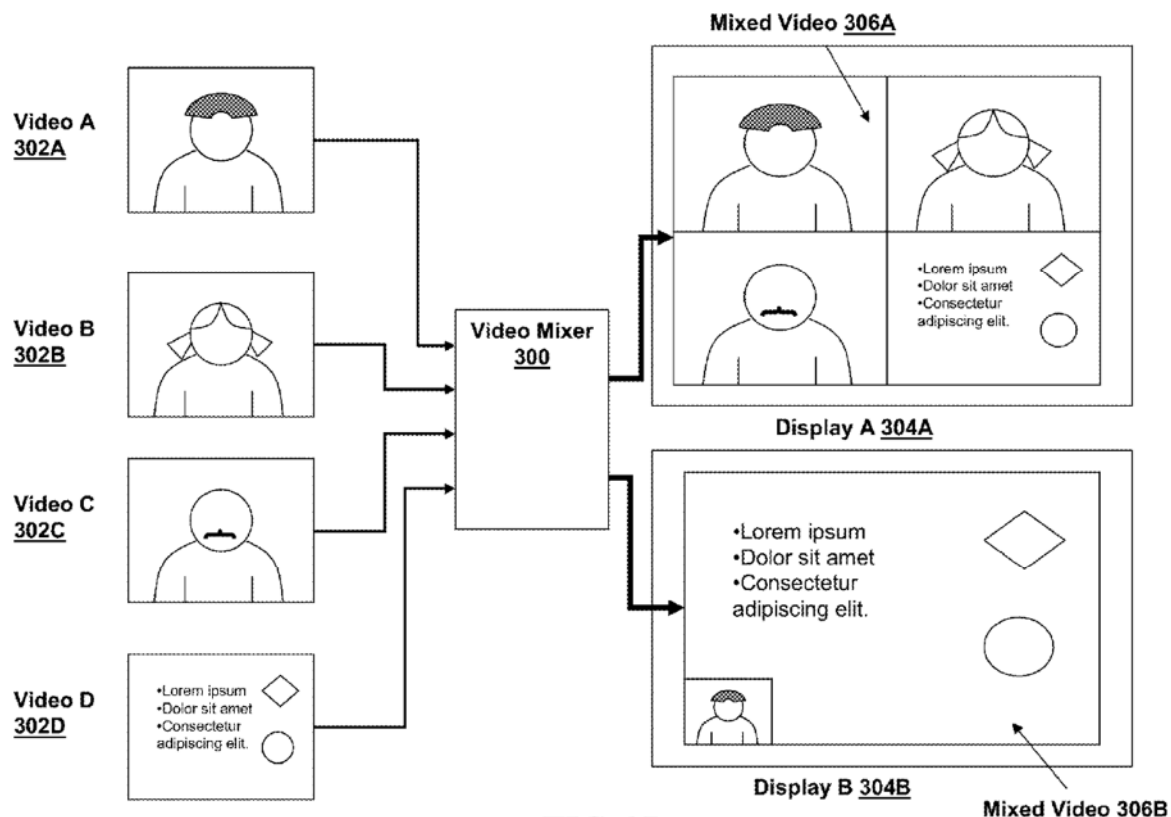


FIG. 3B

a) [Claim 5.pre] “A method”

157. It is my opinion that Weiser discloses “[a] method implemented by a communication device connected to an image capturing apparatus, a first display, and a second display, the method comprising.”

158. Weiser discloses a method performed by computing device 102. Weiser’s own Claim 1 recites a method for providing video conferencing services via an Ethernet adapter, the method comprising the steps of intercepting video streams, mixing them, and transmitting the mixed streams. EX1006, 61:35-65. Weiser’s computing device 102, when executing the Video Conference/Ethernet

module software and video conferencing application 204, performs method steps. The execution of video conferencing software by processors 130 and 155 to intercept, mix, and display video streams inherently is performance of a method. A POSITA would have understood that a processor-based system that performs functional operations through software execution necessarily performs the steps of a method.

159. Weiser's computing device 102, executing video conferencing application 204 and using audio/video media processor 144, performs the method steps of controlling the first and second displays through role-based mixing and dynamic stream management. EX1006, 28:60-29:12, FIG. 3B. The video conferencing application determines mixing arrangements and provides different mixed streams to separate displays (a first mixed video stream 306A for display on a first display 304A and a second mixed video stream 306B for display on a second display 304B). EX1006, 28:60-29:35.

160. The automatic response to the third image supply being finished is likewise performed as a method step. Weiser discloses that "the mixed video streams may be dynamically remixed, for example, as slides or other documents are shown, as different participants take on speaker roles, or responsive to other requirements." EX1006, 29:35-38. When the presentation stream ends, the video conferencing application dynamically remixes the remaining streams, which is a method step

performed by software. The external device manager can “receive a request to close a connection or stop receiving video from a video device,” which triggers the exclusion of that stream from subsequent mixing operations. EX1006, 58:8-12, 58:27-31.

161. Therefore, in my opinion, Weiser anticipates and in the alternative renders obvious “[a] method implemented by a communication device connected to an image capturing apparatus, a first display, and a second display, the method comprising.”

b) [Claim 9.pre] “A non-transitory computer readable medium storing computer executable instructions”

162. It is my opinion that Weiser discloses “[a] non-transitory computer readable medium storing computer executable instructions which, when executed by circuitry of a computer, cause the computer to.”

163. Weiser discloses a non-transitory computer readable medium storing computer-executable instructions. Weiser states that memory of computing device 102 may include one or more suitable type(s) of non-transitory memory, e.g. memory that is not a transitory signal in and of itself, examples of which include but are not limited to: read-only memory (ROM or EPROM), random access memory (RAM), static RAM, dynamic RAM, flash memory, one or more of a hard disk, a zip disk, a floppy disk, a diskette, a CD, a CD-ROM, a DVD, one or more database(s), one or more flat file(s), etc. EX1006, 60:59-61:25.

164. Weiser directly discloses that the memory stores executable instructions. Weiser states the computing device may comprise at least one memory that stores instructions or data. EX1006, 24:5-54. Video Conference/Ethernet module 100 may comprise a library, network driver, or application that is at least partially implemented in software, firmware, or a combination of the two. EX1006, 60:59-61. This software, when executed by the processors 130 and 144, causes computing device 102 to intercept, mix, and display video streams.

165. Weiser discloses that the stored instructions cause the computer to select mixing arrangements based on participant roles and content type, to provide separate mixed streams to separate displays, to dynamically remix streams when slides or documents are shown or cease to be shown, and to respond to closed connections or stopped video reception by excluding those streams from subsequent mixes. EX1006, 28:60-29:12; 57:65-58:2.

166. Therefore, in my opinion, Weiser discloses “[a] non-transitory computer readable medium storing computer executable instructions which, when executed by circuitry of a computer, cause the computer to.”

2. **[Claims 1.a/5.a/9.a] “a transceiver to transmit data of a first captured image captured by the image capturing apparatus via a network; and receive data of a second captured image via the network”**

167. It is my opinion that Weiser discloses “[a] transceiver to transmit data of a first captured image captured by the image capturing apparatus via a network; and receive data of a second captured image via the network.”

168. Weiser discloses that the media controller intercepts a first video stream comprising “a first video capture of the first video conference participant from the first device, such as from a webcam, integrated camera, external USB camera, or other video capture device.” EX1006, 29:56-60. This first video capture from the local participant’s camera is the “first captured image” that is transmitted via the network.

169. Weiser further discloses that the media controller intercepts a second video stream “communicated over a second transport layer connection established between the computing device and a second device of a second video conference participant.” EX1006, 29:61-30:2. This second video stream is “a second video capture of the second video conference participant from the second device.” EX1006, 2:35-38; 31:54-64. The received captured video of the remote participant is the “second captured image” received via the network.

170. Weiser’s system transmits the locally captured video to remote participants and receives their captured video through network connections. The

media controller operates on transport layer connections via the network interface 200, which includes “NIC 142 of Video Conference/Ethernet Module 100.” EX1006, 27:3-20. Computing device 102 communicates with remote devices over a network. EX1006, 27:15-30. The network interface card 142, Ethernet switch 138, and Ethernet bridge 140 within the Video Conference/Ethernet module 100 collectively function as the claimed “transceiver.” EX1006, 20:25-35, FIG. 1D.

171. Therefore, in my opinion, Weiser discloses “[a] transceiver to transmit data of a first captured image captured by the image capturing apparatus via a network; and receive data of a second captured image via the network.”

3. [Claims 1.b/5.b/9.b] “receive data of a third image that is displayed on a display of another communication device via the network, the third image being different than the first captured image and the second captured image”

172. It is my opinion that Weiser discloses “receive data of a third image that is displayed on a display of another communication device via the network, the third image being different than the first captured image and the second captured image.”

173. Weiser discloses that a video stream in the conference may comprise content entirely different from images of participants captured by their cameras. Weiser states: “a participant such as first, second, or third participant, or a fourth participant (not illustrated) may provide a fourth video stream D 302D, which may comprise an application output window or document such as a Microsoft PowerPoint

slideshow, an interactive whiteboard output, a scanner output, a PDF document, a video file, or any other type of static or dynamic video content.” EX1006, 28:55-65. This fourth video stream (stream D 302D) is the “third image.”

174. This third image is “displayed on a display of another communication device” before being transmitted to the local participant. A Microsoft PowerPoint slideshow, interactive whiteboard output, or PDF document is displayed on the screen of the remote participant’s device before the image data is transmitted to the video conference system. Weiser states that “the second device 420B and second video conference participant may be the first device 420A and the first video conference participant, such as where the second video stream comprises an application output window, video file, slideshow, or other dynamic or static content.” EX1006, 29:65-30:5. Thus the application output windows and slideshows are transmitted from participants’ devices and are displayed on those devices before being communicated to the conference.

175. The third image is “different than the first captured image and the second captured image.” While the first and second captured images are video captures from participants’ cameras (webcams) (EX1006, 29:56-60), stream D 302D comprises an “application output window or document such as a Microsoft PowerPoint slideshow.” A POSITA would have understood that this sort of application output or document is not a video camera capture. EX1006, 28:55-65.

176. Therefore, in my opinion, Weiser discloses “receive data of a third image that is displayed on a display of another communication device via the network, the third image being different than the first captured image and the second captured image.”

4. **[Claims 1.c/5.c/9.c] “a display control circuit configured to control the first display and the second display; and in response to supply of the third image being finished while the first display displays the first captured image and the second captured image and the second display displays the third image, automatically control the first display to display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image”**

177. It is my opinion that Weiser anticipates and in the alternative renders obvious “a display control circuit configured to control the first display and the second display; and in response to supply of the third image being finished while the first display displays the first captured image and the second captured image and the second display displays the third image, automatically control the first display to display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image.”

178. **Display Control Circuit:** Weiser’s computing device 102 and Video Conference/Ethernet module 100 include processing hardware and software that control what is displayed on the connected display devices. The Video Conference/Ethernet module 100 includes a processor 130, memory 132, RAM 134,

and an audio/video media processor 144 (video mixer). EX1006, 20:20-35, FIG. 1D. The video conferencing application 204 identifies participant roles and instructs the audio/video media processor to mix video streams “in accordance with a predetermined arrangement or format.” EX1006, 28:10-20. The computing device 102 includes “any type and/or form of video adapter, video card, driver, and/or library to interface, communicate, connect or otherwise use the display devices 175.” EX1006, 25:45-48. These components—processor 130, media processor 144, video adapter, and video conferencing application—collectively constitute a “display control circuit configured to control the first display and the second display.”

179. **Role-Based Display Management:** Weiser discloses that the video conferencing application selects mixing formats or arrangements from “a plurality of predetermined arrangements” based on participant roles, and on the number of participants. EX1006, 3:3-6; 30:8-20. Weiser further discloses that mixed video streams (streams that combine multiple input streams from cameras or other sources) are provided to separate displays based on these arrangements: “video streams 302A-302D may be mixed by a video mixer into a first mixed video stream 306A for display on a first display 304A. The video streams may also be mixed into a second mixed video stream 306B for display on a second display 304B.” EX1006, 29:22-27, FIG. 3B.

180. Weiser also discloses that the video streams of participants are displayed on first display 304A. EX1006, 29:22-35, Fig. 3B. Weiser discloses that the conference application presents “a full-screen or large windowed incoming stream of the remote user, while displaying the camera output of the local user in a small picture-in-picture window.” EX1006, 31:27-30. This confirms that Weiser’s system displays both the local user’s camera output (first captured image) and the remote user’s camera output (second captured image) on the same display.

181. Weiser also discloses a “second mixed video stream 306B comprising the presenter and a presentation” that is provided for display on a second display 304B. EX1006, 29:2-7, 29:26-35, FIG. 3B. Weiser discloses a role-based, purpose-driven display arrangement where the first and second images (from local and remote cameras) are displayed on one monitor, and a third image (such as a presentation) is provided on a second monitor.

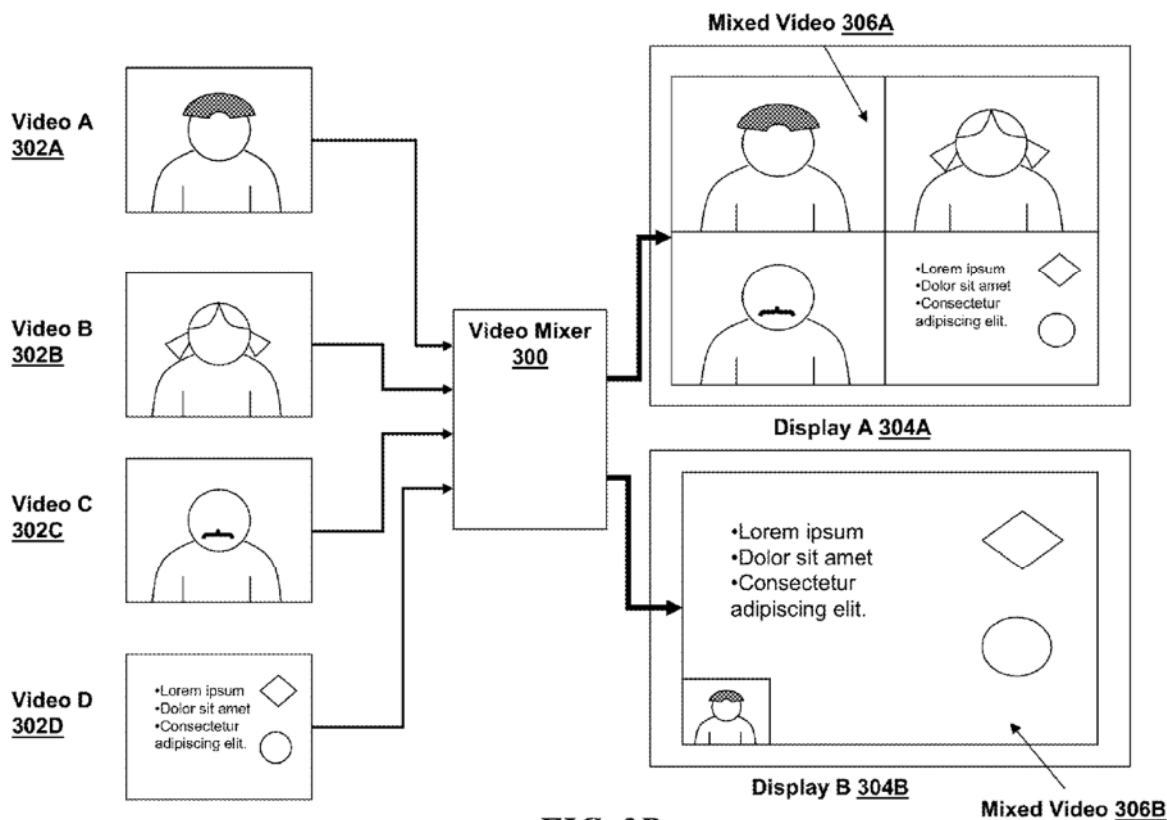


FIG. 3B

182. **Dynamic Remixing When the Presenter Role Changes:** Weiser discloses that “the mixed video streams may be dynamically remixed, for example, as slides or other documents are shown, as different participants take on speaker roles, or responsive to other requirements.” EX1006, 29:35-38, FIG. 3B.

183. Weiser thus discloses that the video streams sent to each of the two monitors can be changed to incorporate different images as participants change their roles. Weiser discloses that one of the participant roles is “presenter.” EX1006, 4:33-44. As a result, when the roles of participants change and a first presenter (whose presentation image is currently being displayed on second display 304B) is replaced in the role of presenter by another participant, supply of the third image

(corresponding to the first presenter) is “finished” and will be removed from second display 304B (the image of the first presenter, if present on that display, will also be removed for the same reason). These images will be replaced with images corresponding to the second presenter, because the second presenter has assumed a “presenter” role, and Weiser discloses that display arrangement dynamically changes based on changes in participant roles.

184. Due to Weiser’s dynamic remixing based on participant roles changing, when a presenter is replaced with a different presenter then the second display is controlled so as to display none of the first, second, or third image.

185. The first display 304A continues to display the first and second images, as, regardless of the change in presenter role, Weiser discloses that first display 304A displays images of the participants, captured by their cameras, and the first presenter and second presenter are still participants.²

186. **The Transition Is Automatic:** The video conferencing application determines mixing formats and instructs the audio/video media processor to process and mix streams. EX1006, 30:40-55. The dynamic remixing occurs responsive to

² This assumes, of course, that the new presenter does not correspond to the first or second image. In any situation where there are more than three participants, there will be a “first image” and “second image” that are not provided on the second display after a change in presenter.

changes in participant roles without requiring a user to manually reconfigure the display. EX1006, 29:36-39.

187. Dynamic Remixing When the Third Image Supply Is Finished:

Weiser's dynamic remixing also encompasses the scenario where slides or documents are no longer being shown because the presenter is done—i.e., the supply of the third image is “finished.” When the slideshow or document stream ends, the video conferencing application would be understood to dynamically remix the video streams to reflect the changed conference state such that the “third image” is not shown on the second display and the third image also is not shown on the first display.

188. Weiser discloses this concept in the context of external video producing devices. The external device manager is “configurable to receive a request to close a connection or stop receiving video from a video device.” EX1006, 58:8-12. When a connection to an external video source is closed or video reception stops, the system ceases receiving that video stream—the supply of that content has “finished.” At that point, the video mixing functionality would remix the remaining participant video streams without the external content. EX1006, 59:50-60:5. The system “mix[es] each of these video streams into a single mixed video” and “may mix in the video from the video device in accordance to any mixing format or arrangement.” EX1006, 59:55-60:5. When the external video device is disconnected, the mixing

would have no choice but to exclude that stream, since it no longer exists. As a result, the stream would necessarily exclude images of the presentation.

189. Based on Weiser's disclosures, when the third image (presentation/document stream) supply is finished: (1) the first display would continue to display the first and second captured images (participant camera feeds), because those streams remain active in the video conference and are unaffected by termination of the presentation/document stream; and (2) the second display would display "none of the first captured image, the second captured image, and the third image," because the content stream that was being mixed into the stream displayed on the second display no longer exists, and can therefore no longer be mixed into the display stream for that display. The dynamic remixing would automatically update the display arrangement to reflect the absence of the presentation stream. Even if another presenter presents after the third image is finished, and assuming there are more than three participants, the claim is still met because it only requires that display 2 display none of images 1, 2, and 3.

190. **The Transition Is Automatic:** The video conferencing application determines mixing formats and instructs the audio/video media processor to process and mix streams without manual user intervention at the receiving end. EX1006, 30:44-31:3. The dynamic remixing occurs "responsive to other requirements"—which would include the cessation of a content stream, and does not require the local

user to reconfigure the display. EX1006, 29:22-39. Thus, when a video stream ends (e.g., the PowerPoint slideshow concludes and the application output window is closed), the video conferencing application and media processor would automatically remix the remaining streams, resulting in the second display no longer showing the image corresponding to the video stream. This is the natural, predictable result of Weiser's dynamic remixing architecture.

191. **Alternative Obviousness Rationale:** It is my opinion that Weiser discloses removing the third image from the second display because (1) Weiser discloses that the second display receives and displays a stream that is the mixture of other streams that include the third image, and (2) Weiser's stream mixer would no longer have the third image as an input once that stream is finished. However, I have also considered whether, if it is argued that Weiser does not describe removing the third image from the second display when the third image supply ends, this result would have been obvious to a POSITA. It is my opinion that it would have been.

192. Weiser discloses: (1) dual-display configurations for video conferencing; (2) role-based and content-based mixing arrangements; (3) dynamic remixing when slides or documents are shown or cease to be shown; and (4) the ability to close connections to external video sources. EX1006, 25:36-58; 28:62-29:39; 57:64-58:13.

193. An argument that Weiser doesn't disclose clearing content from the second display when sharing of that content is finished would require that, contrary to Weiser's express disclosure, somehow the second display receives images that are not provided for mixture into the mixed stream that it displays. If some theory is advanced that this is somehow possible, so that Weiser doesn't disclose clearing content from the second display when sharing of that content is finished, it is my opinion that a POSITA would have been motivated to clear the content from the second display in any case because displaying a frozen or stale image after the presentation is over would confuse conference participants. A POSITA would have had a reasonable expectation of success because Weiser's architecture already provides the mechanisms for dynamically adjusting the mixing arrangement according to different requirements, and is a stream-mixing architecture which necessarily takes into account the presence and quantity of streams which need to be mixed; in other words, Weiser already provides a flexible mechanism for including or excluding images in the display stream.

194. Therefore, in my opinion, Weiser anticipates and in the alternative renders obvious "a display control circuit configured to control the first display and the second display; and in response to supply of the third image being finished while the first display displays the first captured image and the second captured image and the second display displays the third image, automatically control the first display to

display the first captured image and the second captured image and control the second display to display none of the first captured image, the second captured image, and the third image.”

5. [Claims 2/6] “wherein the third image comprises one of a desktop screen and a user interface of an application program”

195. It is my opinion that Weiser discloses “wherein the third image comprises one of a desktop screen and a user interface of an application program.”

196. Weiser discloses that the fourth video stream D 302D “may comprise an application output window or document such as a Microsoft PowerPoint slideshow, an interactive whiteboard output, a scanner output, a PDF document, a video file, or any other type of static or dynamic video content.” EX1006, 28:57-62, FIG. 3A. An “application output window,” by definition, may include “a user interface of an application program”—it is the visual output rendered by a running application within a windowed graphical user interface. An “application output window” constitutes a window displayed by an application program, which typically includes “a user interface of an application program.”

197. Weiser also discloses that a video stream may comprise the output of a computing device’s display, which encompasses a “desktop screen.” Weiser states that in some embodiments, “the second video stream may comprise an image, document, application output window, file, video, or other displayed information.” EX1006, 31:62-64. The phrase “other displayed information” is broad enough to

encompass the entirety of a desktop screen. When Weiser refers to sharing an “application output window” or “other displayed information” from a participant’s device, this encompasses sharing the participant’s desktop screen or any application user interface visible on that screen.

198. Additionally, Weiser discloses that “video stream D 302D may be provided by a video driver or video conferencing application of the video mixing system. For example, video stream D 302D may comprise titles, captions, logos, animations, scrolls, status indicators, or other visual indicators that may be placed alongside or overlaid on video streams 302A-302C.” EX1006, 28:55-29:2. These visual elements—titles, captions, status indicators—are standard components of application program user interfaces.

199. Therefore, in my opinion, Weiser discloses “wherein the third image comprises one of a desktop screen and a user interface of an application program.”

6. [Claims 3/7] “wherein the third image comprises an image created by using one of word-processing software, spreadsheet software, and presentation software”

200. It is my opinion that Weiser discloses “wherein the third image comprises an image created by using one of word-processing software, spreadsheet software, and presentation software.”

201. Weiser names presentation software as a source of the shared content stream. Weiser states that the fourth video stream D 302D “may comprise an

application output window or document such as a Microsoft PowerPoint slideshow, an interactive whiteboard output, a scanner output, a PDF document, a video file, or any other type of static or dynamic video content.” EX1006, 28:57-62; Fig. 3B. Microsoft PowerPoint is presentation software. A Microsoft PowerPoint slideshow is “an image created by using ... presentation software.”

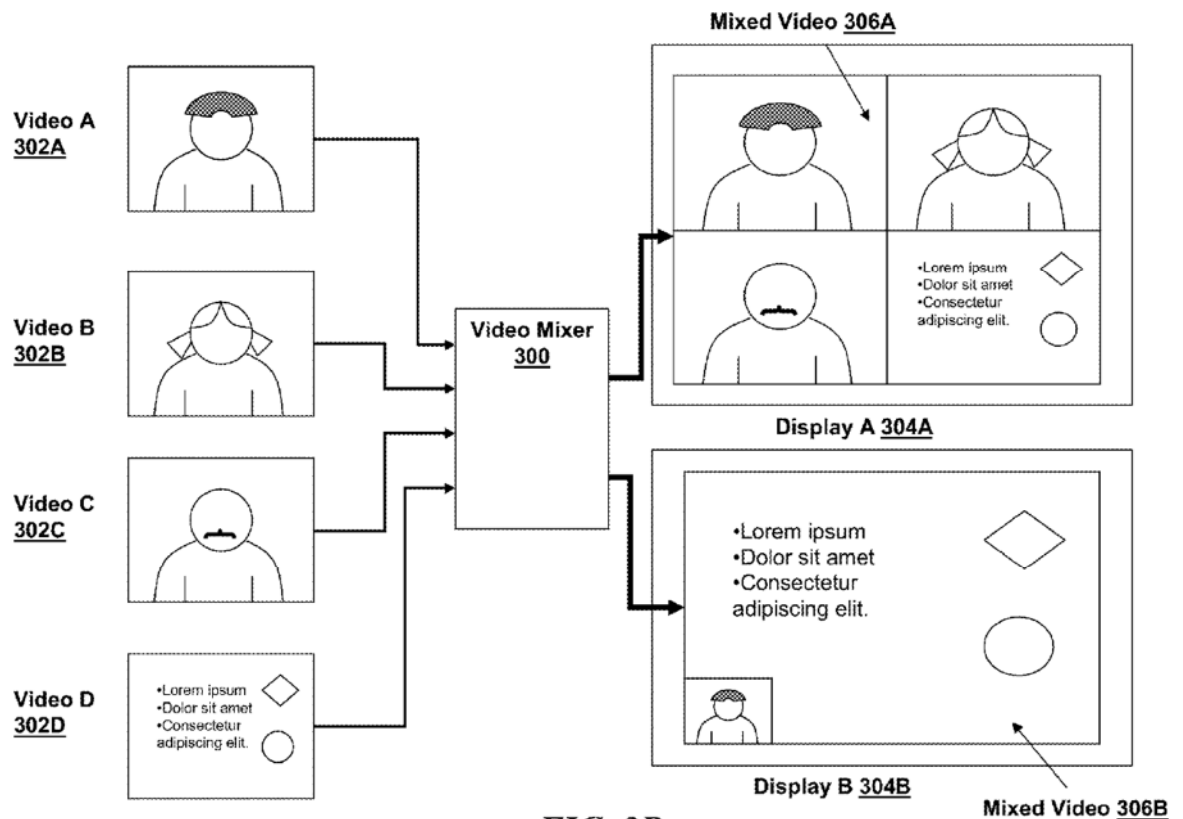


FIG. 3B

202. Weiser also discloses “a PDF document” as a video stream source. EX1006, 28:60. PDF documents were commonly created by exporting or printing from word-processing software (such as Microsoft Word), spreadsheet software (such as Microsoft Excel), or presentation software (such as Microsoft PowerPoint).

A “PDF document” shared during a video conference would often be an image “created by using one of word-processing software, spreadsheet software, and presentation software,” since those are common applications from which PDF documents are generated.

203. Furthermore, Weiser discloses that the shared content stream may comprise “an application output window or document.” EX1006, 28:44-62. The phrase “application output window” encompasses the output of any running and displayed application, including word-processing software displaying a document, spreadsheet software displaying a workbook, or presentation software displaying slides.

204. Weiser also discloses that the system supports dynamic remixing “as slides or other documents are shown.” EX1006, 29:22-39. The term “slides” in this context refers to presentation slides—content created using presentation software.

205. Therefore, in my opinion, Weiser discloses “wherein the third image comprises an image created by using one of word-processing software, spreadsheet software, and presentation software.”

7. [Claims 4/8/10] “an operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme, wherein according to the first display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display none of the first captured image, the second captured image, and the third image, and according to the second display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display the third image”

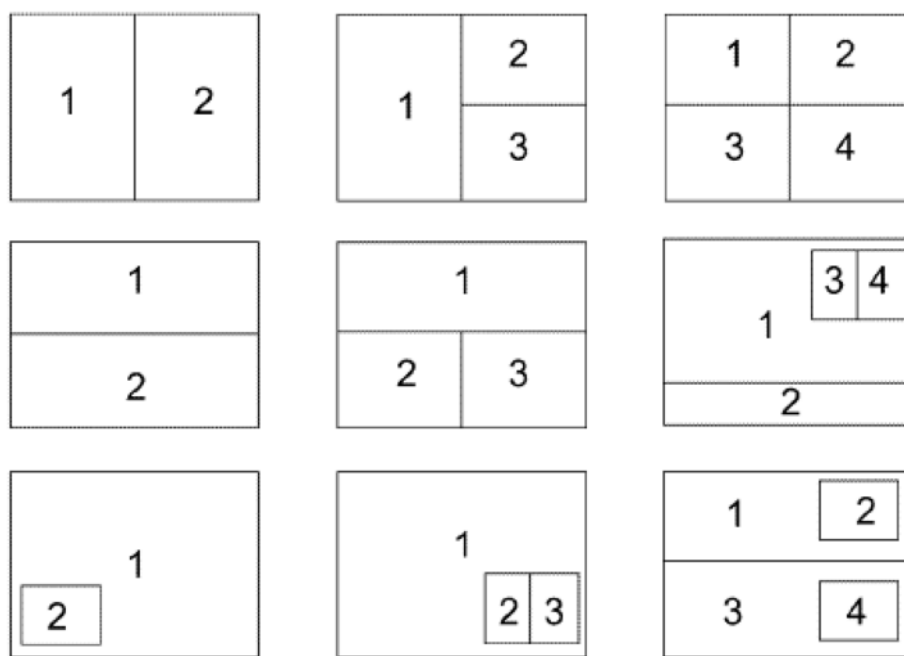
206. It is my opinion that Weiser anticipates and in the alternative renders obvious “an operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme, wherein according to the first display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display none of the first captured image, the second captured image, and the third image, and according to the second display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display the third image.”

207. **The “First Display Scheme” and “Second Display Scheme” in Weiser:** Under Weiser’s “first display scheme” (which corresponds to no active presentation), the first display shows participant camera feeds (the first and second captured images in a PIP or split-screen arrangement) and the second display shows no content—i.e., “none of the first captured image, the second captured image, and

the third image.” EX1006, 29:22-39; 25:36-48. No presentation stream is active, so nothing is assigned to the second display.

208. Under Weiser’s “second display scheme” (in which there is someone in the presenter role, sharing a presentation), the first display continues to show participant camera feeds (first and second captured images) and the second display shows the shared content stream—“a second mixed video stream 306B comprising the presenter and a presentation.” EX1006, 28:36-29:39.

209. **Weiser’s Changing Between Mixing Formats:** Weiser discloses that the video conferencing application selects mixing formats from “a plurality of predetermined arrangements” based on participant roles and conference state. EX1006, 3:3-6; 30:8-20, Fig. 3C.



Mixed Video Arrangements/Formats

FIG. 3C

210. Weiser also discloses that “the mixed video streams may be dynamically remixed, for example, as slides or other documents are shown, as different participants take on speaker roles, or responsive to other requirements.” EX1006, 29:35-38, FIG. 3B. This dynamic remixing between different display arrangements from a non-presentation format (no slides) to a presentation format (with slides) and back corresponds to changing between the first and second display schemes.

211. The transition to the “second display scheme” occurs when a participant assumes the presenter role and begins sharing slides or documents. Weiser states

that stream D 302D may be “provided” by a participant during the conference. EX1006, 28:42-67. In the context of external video producing devices, Weiser discloses that a user of the computing device or an administrator of the video conference may want to “seamlessly integrate video from an external video producing device ... into the video conference.” EX1006, 54:40-55. The user’s request to integrate the external video or share a document initiates the transition from the first display scheme to the second.

212. The transition back to the “first display scheme” occurs when the presenter stops sharing. Weiser discloses that the external device manager is “configurable to receive a request to close a connection or stop receiving video from a video device.” EX1006, 58:8-12. When the user stops sharing, the system transitions from the second display scheme (shared content on display) back to the first (no shared content).

213. Role-Based Selection Constitutes Changing Between Display Schemes: Weiser discloses that “the first conference participant may log in as a presenter to an authentication system, and the authentication system may notify the video conferencing application that the conference participant is a presenter.” EX1006, 32:9-13. Once a participant assumes the “presenter” role, the video conferencing application selects a mixing format that includes the presenter’s shared content on a second display (the “second display scheme”). When the participant

relinquishes the presenter role or the presentation stream ends, the system reverts to a non-presentation mixing format (the “first display scheme”). EX1006, 32:10-25.

214. Weiser further discloses that the system can generate different mixed streams for different roles simultaneously: “A first mixed video stream 306A may be provided to the presenter, so that he or she may view feedback from viewer participants, while a second mixed video stream 306B comprising the presenter and a presentation may be provided to the viewer participants.” EX1006, 29:30-35. A POSITA would have understood that in a dual-display configuration, the transition between a state with presentation content on the second display and a state without it is triggered by a user assuming or relinquishing a presenter role or a user starting or stopping a presentation, both of which are “instruction[s] to change between a first display scheme and a second display scheme.”

215. **The “Operation Receiving Circuit”:** Weiser’s computing device 102 includes components that receive user instructions. Weiser discloses that computing device 102 includes optional user interface and one or more I/O devices 178a-178n. EX1006, 23:49-61; 25:25-58. The computing device processes inputs through its operating system and video conferencing application 204. EX1006, 28:10-20. The video conferencing application 204 “may comprise functionality for identifying one or more participants of a video conference and one or more respective roles of participants” and “may identify a video stream as corresponding to an identified role

of a participant, and may generate a request for audio/video media processor 206 to mix the video stream in accordance with a predetermined arrangement or format.”
EX1006, 28:10-25.

216. The processor 130 of computing device 102, together with the user interface 175 and I/O devices 178, collectively constitutes an “operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme.” When a user initiates screen sharing or begins sharing content, the video conferencing application receives this instruction and changes the mixing arrangement from one without shared content (first scheme) to one with shared content (second scheme). When the user stops sharing or closes the slideshow, the application receives this instruction and reverts to the first scheme.

217. Therefore, in my opinion, Weiser anticipates and in the alternative renders obvious “an operation receiving circuit configured to receive an instruction to change between a first display scheme and a second display scheme, wherein according to the first display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display none of the first captured image, the second captured image, and the third image, and according to the second display scheme, the first display is controlled to display the first captured image and the second captured image and the second display is controlled to display the third image.”

IX. CONCLUSION

218. It is my opinion that the Challenged Claims are anticipated and rendered obvious for the reasons I have set forth.

* * *

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

Executed on: July 10, 2026


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Education

- Ph.D.** June 1997 *Georgia Institute of Technology* Computer Science
Dissertation Title: Networking and System Support for the Efficient,
Scalable Delivery of Services in Interactive Multimedia Systems
Minor: Telecommunications Public Policy
- M.S.** June 1994 *Georgia Institute of Technology* Computer Science
Specialization: Networking and Systems
- B.S.** June 1992 *Georgia Institute of Technology* Information and Computer Science
(high honors) *Minors:* Economics, Technical Communication, American Literature

Employment History

Professor Emeritus	Department of Computer Science University of California Santa Barbara, CA	Nov 2020 -- present
Professor	Department of Computer Science University of California Santa Barbara, CA	Jul 2005 -- Oct 2020
Associate Dean	College of Engineering University of California Santa Barbara, CA	Mar 2007 -- Aug 2009
Vice Chair	Department of Computer Science University of California Santa Barbara, CA	Jul 2000 -- Nov 2005

Associate Professor	Department of Computer Science University of California Santa Barbara, CA	Jul 2001 -- Jun 2005
Assistant Professor	Department of Computer Science University of California Santa Barbara, CA	Jul 1997 -- Jun 2001
Graduate Researcher	Broadband Telecommunications Center Georgia Center for Adv Telecom Tech Atlanta, GA	Sep 1996--Jun 1997
Graduate Intern	IBM T.J. Watson Research Labs Hawthorne, NY	Jun 1995--Sep 1995
Support Specialist	Office of Information Technology Georgia Institute of Technology Atlanta, GA	Sep 1995--Jun 1997
Research Assistant	College of Computing Georgia Institute of Technology Atlanta, GA	Jan 1994--Mar 1994
Graduate Intern	Hitachi Telecommunications Norcross, GA	Jun 1992--Sep 1992
Undergraduate Intern	IBM Research Triangle Park, NC	Jun 1989--Sep 1989 Jun 1990--Sep 1990 Mar 1991--Sep 1991

Industry Technical Advising

Board of Directors	The New Media Studio Santa Barbara, CA	Nov 2006 -- present
Co-Founder & Chairman of the Board	Santa Barbara Labs, LLC Santa Barbara, CA	Sep 2007 -- Dec 2009
Board of Advisors	Techknowledge Point Santa Barbara, CA	May 2001 -- Dec 2007
Technical Advisory Board	Occam Networks, Inc. Santa Barbara, CA	May 2000 -- Dec 2010
Board of Advisors	Airplay Inc. San Francisco, CA	Jun 2005 -- Aug 2009
Consultant	Lockheed Martin Corporation San Jose, CA	Nov 1999 -- Jun 2009

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Board of Advisors	Santa Barbara Technology Group Santa Barbara, CA	Sep 2000 -- Dec 2004
Board of Directors	Virtual Bandwidth, Inc. Santa Barbara, CA	Nov 2000 -- Jun 2001
Board of Advisors & Affiliated Scientist	Digital Fountain San Francisco, CA	Jan 2000 -- Dec 2001
Senior Technologist	IP Multicast Initiative, Stardust Forums Campbell, CA	Jun 1998 -- Dec 2000

I. Teaching

A. Courses Taught

CS 176A	Intro to Computer Communication Networks	Fall 1997, Fall 1998, Fall 2002, Fall 2003, Fall 2004, Spring 2005, Spring 2006, Spring 2007, Spring 2008, Fall 2008, Fall 2009, Fall 2010, Fall 2011, Fall 2012, Fall 2013, Fall 2014, Spring 2017, Spring 2018, Spring 2020, Fall 2020
CS 176B	Network Computing	Winter 2000, Winter 2001, Winter 2002, Winter 2012, Winter 2014, Winter 2015, Winter 2018, Winter 2019, Winter 2020
MAT 201B	Media Networks and Services	Fall 1999, Fall 2000, Fall 2001, Fall 2003
CS 276	Distributed Computing and Computer Networks	Winter 1999, Spring 2000, Fall 2002, Fall 2005, Fall 2018
CS 290I	Networking for Multimedia Systems	Winter 1998, Spring 1999, Fall 2004, Winter 2010
CS 595N	Technology and Society	Winter 2005, Fall 2005, Spring 2006, Fall 2006, Spring 2007, Fall 2007, Spring 2008, Fall 2008, Spring 2009
CS 595N	Economic Systems Seminar	Winter 2004, Spring 2004, Winter 2005, Spring 2005
CS 595N	Networking Seminar	Winter 1999, Fall 1999, Winter 2003, Winter 2019
CS 595N	Wireless Networking & Multimedia Seminar	Fall 2000
CS 595I	Systems Design and Implementation Seminar	Fall 1999, Fall 2000, Winter 2001, Spring 2001, Winter 2002, Spring 2002

B. Other Teaching Experience

- *The Evolution of Advanced Networking Services: From the ARPAnet to Internet2*, Instructor, Summer 2001. Short course taught at Escuela de Ciencias Informatica (ECI) sponsored by the Universidad de Buenos Aires.

- *Johns Hopkins Center for Talented Youth*, Instructor, Summer 1994. CTY is a program to teach gifted high school students the fundamentals of computer science.
- *Georgia Institute of Technology*, Graduate Teaching Assistant, Sep 1994--Sep 1996. Worked as a TA for 12 quarters teaching 7 different courses (4 undergraduate and 3 graduate).

C. Ph.D. Students Advised [14 graduated]

14. Daniel Havey
 Research Area: *Throughput and Delay on the Packet Switched Internet*
 Date Graduated: Winter 2015
 First Position: Microsoft
13. Lara Deek (co-advised with E. Belding)
 Research Area: *Resource-Efficient Wireless Systems for Emerging Wireless Networks*
 Date Graduated: Summer 2014
 First Position: Post Doc, UIUC
12. Mike Wittie
 Research Area: *Towards Sustained Scalability of Communication Networks*
 Date Graduated: Summer 2011
 First Position: Assistant Professor, Montana State University
11. Allan Knight
 Research Area: *Supporting Integration of Educational Technologies and Research of Their Effects on Learning*
 Date Graduated: Summer 2009
 First Position: Research Scientist, Citrix Online
10. Hangjin Zhang
 Research Area: *Towards Blended Learning: Educational Technology to Improve and Assess Teaching and Learning*
 Date Graduated: Spring 2009
 First Position: Microsoft
9. Gayatri Swamynathan
 Dissertation Title: *Towards Reliable Reputations for Distributed Applications*
 Date Graduated: Spring 2008
 First Position: Zynga
8. Amit Jardosh (co-advised with E. Belding)
 Dissertation Title: *Adaptive Large-Scale Wireless Networks: Measurements, Protocol Designs, and Simulation Studies*
 Date Graduated: Fall 2007
 First Position: Yahoo!
7. Khaled Harras
 Dissertation Title: *Protocol and Architectural Challenges in Delay and Disruption Tolerant Networks*
 Date Graduated: Summer 2007
 First Position: Assistant Professor, Carnegie Mellon University
6. Krishna Ramachandran (co-advised with E. Belding)
 Dissertation Title: *Design, Deployment, and Management of High-Capacity Wireless Mesh Networks*
 Date Graduated: Winter 2006
 First Position: Research Scientist, Citrix Online

5. Robert Chalmers
Dissertation Title: *Improving Device Mobility with Intelligence at the Network Edge*
Date Graduated: Summer 2004
First Position: President and CEO, Limbo.net
4. Prashant Rajvaidya
Dissertation Title: *Achieving Robust and Secure Deployment of Multicast*
Date Graduated: Spring 2004
First Position: President and CTO, Mosaic Networking
3. Sami Rollins
Dissertation Title: *Overcoming Resource Constraints to Enable Content Exchange Applications in Next-Generation Environments*
Date Graduated: Spring 2003
First Position: Assistant Professor, Mount Holyoke College
2. Srinivasan Jagannathan
Dissertation Title: *Multicast Tree-Based Congestion Control and Topology Management*
Date Graduated: Spring 2003
First Position: Consultant, Kelly & Associates
1. Kamil Sarac
Dissertation Title: *Supporting a Robust Multicast Service in the Global Infrastructure*
Date Graduated: Spring 2002
First Position: Assistant Professor, UT-Dallas

D. M.S. Students Advised (Thesis/Project Option) [19 graduated]

19. Neer Shey
Research Area: *Analyzing Content Distribution Through Opportunistic Contact for Smart Cellular Phones*
Date Graduated: Spring 2010
18. Camilla Fiorese
Research Area: *Analysis of a Pure Rate-Based Congestion Control Algorithm*
Date Graduated: Summer 2009
17. Brian Weiner
Research Area: *Multi-Socket TCP: A Simple Approach to Improve Performance of Real-Time Applications over TCP*
Date Graduated: Fall 2007
16. Avijit Sen Mazumder
Research Area: *Facilitating Robust Multicast Group Management*
Date Graduated: Fall 2005
15. Rishi Matthew
Thesis Title: *Providing Seamless Access to Multimedia Content on Heterogeneous Platforms*
Date Graduated: Summer 2004
14. Camden Ho
Research Area: *Tools and Techniques for Wireless Network Management*
Date Graduated: Spring 2004
13. Amit Jardosh (co-advised with E. Belding)
Research Area: *Realistic Environment Models for Mobile Network Evaluation*
Date Graduated: Spring 2004
12. Nitin Solanki
Research Area: *SongWand: A Wireless Barcode Scanner Using Bluetooth Technology*

- Date Graduated: Winter 2004
11. Vrishali Wagle (co-advised with E. Belding)
Research Area: *An Ontology-Based Service Discovery Mechanism*
Date Graduated: Winter 2004
 10. Uday Mohan
Thesis Title: *Scalable Service Discovery in Mobile Ad hoc Networks*
Date Graduated: Spring 2003
 9. Krishna Ramachandran
Thesis Title: *Ubiquitous Multicast*
Date Graduated: Spring 2003
 8. John Slonaker
Thesis Title: *Inductive Loop Signature Acquisition Techniques*
Date Graduated: Spring 2002
 7. Mohammad Battah
Thesis Title: *Dedicated Short-Range Communications Intelligent Transportation Systems Protocol (DSRC-ITS)*
Date Graduated: Spring 2002
 6. Kevin Vogel
Thesis Title: *Integrating E-Commerce Applications into Existing Business Infrastructures*
Date Graduated: Spring 2001
 5. Sami Rollins
Thesis Title: *Audio Xml: Aural Interaction with XML Documents*
Date Graduated: Winter 2000
 4. Andy Davis
Thesis Title: *Stream Scheduling for Data Servers in a Scalable Interactive TV System*
Date Graduated: Spring 1999
 3. David Makofske
Thesis Title: *MHealth: A Real-Time Graphical Multicast Monitoring Tool*
Date Graduated: Winter 1999
 2. Prashant Rajvaidya
Thesis Title: *MANTRA: Router-Based Monitoring and Analysis of Multicast Traffic*
Date Graduated: Winter 1999
 1. Alex DeCastro (co-advised with Yuan-Fang Wang)
Thesis Title: *Web-Based Collaborative 3D Modeling*
Date Graduated: Winter 1998

E. Teaching Awards

2006-2007 UCSB Academic Senate Distinguished Teaching Award
2004-2005 Computer Science Outstanding Faculty Member
2000-2001 UCSB Spotlight on Excellence Award
1999-2000 Computer Science Outstanding Faculty Member (co-recipient)
1998-1999 Computer Science Outstanding Faculty Member (co-recipient)
1997-1998 Computer Science Outstanding Faculty Member

II. Research

A. Journal Papers, Magazine Articles, Books, and Book Chapters

62. L. Deek, E. Garcia-Villegas, E. Belding, S.J. Lee, and K. Almeroth, "[A Practical Framework for 802.11 MIMO Rate Adaptation](#)," *Computer Networks*, vol. 83, num. 6, pp. 332-348, June 2015.
61. L. Deek, E. Garcia-Villegas, E. Belding, S.J. Lee, and K. Almeroth, "[Intelligent Channel Bonding in 802.11n WLANs](#)," *IEEE Transactions on Mobile Computing*, vol. 13, num. 6, pp. 1242-1255, June 2014.
60. H. Zhang and K. Almeroth, "[Alternatives for Monitoring and Limiting Network Access to Students in Network-Connected Classrooms](#)," *Journal of Interactive Learning Research (JILR)*, vol. 24, num. 3, pp. 237-265, July 2013.
59. M. Tavakolifard and K. Almeroth, "[A Taxonomy to Express Open Challenges in Trust and Reputation Systems](#)," *Journal of Communications*, vol. 7, num. 7, pp. 538-551, July 2012.
58. M. Tavakolifard and K. Almeroth, "[Social Computing: An Intersection of Recommender Systems, Trust/Reputation Systems, and Social Networks](#)," *IEEE Network*, vol. 26, num. 4, pp. 53-58, July/August 2012.
57. M. Tavakolifard, K. Almeroth, and P. Ozturk, "[Subjectivity Handling of Ratings for Trust and Reputation Systems: An Abductive Reasoning Approach](#)," *International Journal of Digital Content Technology and its Applications (JDCTA)*, vol. 5, num. 11, pp. 359-377, November 2011.
56. R. Raghavendra, P. Acharya, E. Belding and K. Almeroth, "[MeshMon: A Multi-Tiered Framework for Wireless Mesh Network Monitoring](#)," *Wireless Communications and Mobile Computing (WCMC) Journal*, vol. 11, num. 8, pp. 1182-1196, August 2011.
55. A. Knight and K. Almeroth, "[Automatic Plagiarism Detection with PAIRwise 2.0](#)," *Journal of Interactive Learning Research (JILR)*, vol. 22, num. 3, pp. 379-400, July 2011.
54. V. Kone, M. Zheleva, M. Wittie, B. Zhao, E. Belding, H. Zheng, and K. Almeroth, "[AirLab: Consistency, Fidelity and Privacy in Wireless Measurements](#)," *ACM Computer Communications Review*, vol. 41, num. 1, pp. 60-65, January 2011.
53. G. Swamynathan, K. Almeroth, and B. Zhao, "[The Design of a Reliable Reputation System](#)," *Electronic Commerce Research Journal*, vol. 10, num. 3-4, pp. 239-270, December 2010.
52. P. Acharya, A. Sharma, E. Belding, K. Almeroth and K. Papagiannaki, "[Rate Adaptation in Congested Wireless Networks through Real-Time Measurements](#)," *IEEE Transactions on Mobile Computing*, vol. 9, num. 11, pp. 1535-1550, November 2010.
51. R. Raghavendra, E. Belding, K. Papagiannaki, and K. Almeroth, "[Unwanted Link Layer Traffic in Large IEEE 802.11 Wireless Networks](#)," *IEEE Transactions on Mobile Computing*, vol. 9, num. 9, pp. 1212-1225, September 2010.
50. H. Zhang and K. Almeroth, "[Moodog: Tracking Student Activity in Online Course Management Systems](#)," *Journal of Interactive Learning Research (JILR)*, vol. 21, num. 3, pp. 407-429, July 2010.
49. R. Chertov and K. Almeroth, "[Qualitative Comparison of Link Shaping Techniques](#)," *IEEE Transactions on Mobile Computing*, vol. 10, num. 1, pp. 1-11, January 2011.

48. A. Knight and K. Almeroth, "[Fast Caption Alignment for Automatic Indexing of Audio](#)," International Journal of Multimedia Data Engineering and Management, vol. 1, num. 2, pp. 1-17, April-June 2010.
47. K. Harras and K. Almeroth, "[Scheduling Messengers in Disconnected Clustered Mobile Networks](#)," Ad Hoc & Sensor Wireless Networks, vol. 9, num. 3-4, pp. 275-304, March-April 2010.
46. A. Jardosh, K. Papagiannaki, E. Belding, K. Almeroth, G. Iannaccone, and B. Vinnakota, "[Green WLANs: On-Demand WLAN Infrastructures](#)," ACM Journal on Mobile Networks and Applications (MONET), vol. 14, num. 6, pp. 798-814, December 2009.
45. M. Wittie, K. Harras, K. Almeroth, and E. Belding, "[On the Implications of Routing Metric Staleness in Delay Tolerant Networks](#)," Computer Communications Special Issue on Delay and Disruption Tolerant Networking, vol. 32, num. 16, pp. 1699-1709, October 2009.
44. K. Harras, L. Deek, C. Holman, and K. Almeroth, "[DBS-IC: An Adaptive Data Bundling System for Intermittent Connectivity](#)," Computer Communications Special Issue on Delay and Disruption Tolerant Networking, vol. 32, num. 16, pp. 1687-1698, October 2009.
43. S. Karpinski, E. Belding, K. Almeroth, and J. Gilbert, "[Linear Representations of Network Traffic](#)," ACM Journal on Mobile Networks and Applications (MONET), vol. 14, num. 4, pp. 368-386, August 2009.
42. K. Harras and K. Almeroth, "[Controlled Flooding in Disconnected Sparse Mobile Networks](#)," Wireless Communications and Mobile Computing (WCMC) Journal, vol. 9, num. 1, pp. 21-33, January 2009.
41. R. Mayer, A. Stull, K. DeLeeuw, K. Almeroth, B. Bimber, D. Chun, M. Bulger, J. Campbell, A. Knight, and H. Zhang, "[Clickers in College Classrooms: Fostering Learning with Questioning Methods in Large Lecture Classes](#)," Contemporary Educational Psychology, vol. 34, num. 1, pp. 51-57, January 2009.
40. A. Knight, K. Almeroth, and B. Bimber, "[Design, Implementation and Deployment of PAIRwise](#)," Journal of Interactive Learning Research (JILR), vol. 19, num. 3, pp. 489-508, July 2008.
39. A. Garyfalos and K. Almeroth, "[Coupons: A Multilevel Incentive Scheme for Information Dissemination in Mobile Networks](#)," IEEE Transactions on Mobile Computing, vol. 7, num. 6, pp. 792-804, June 2008.
38. I. Sheriff, K. Ramachandran, E. Belding, and K. Almeroth, "[A Multi-Radio 802.11 Mesh Network Architecture](#)," ACM Journal on Mobile Networks and Applications (MONET), vol. 13, num. 1-2, pp. 132-146, April 2008.
37. M. Bulger, R. Mayer, K. Almeroth, and S. Blau, "[Measuring Learner Engagement in Computer-Equipped College Classrooms](#)," Journal of Educational Multimedia and Hypermedia, vol. 17, num. 2, pp. 129-143, April 2008.
36. G. Swamynathan, B. Zhao, and K. Almeroth, "[Exploring the Feasibility of Proactive Reputations](#)," Concurrency and Computation: Practice and Experience, vol. 20, num. 2, pp. 155-166, February 2008.
35. G. Swamynathan, B. Zhao, K. Almeroth, and H. Zheng, "[Globally Decoupled Reputations for Large Distributed Networks](#)," Advances in Multimedia, vol. 2007, pp. 1-14, 2007.

34. R. Mayer, A. Stull, J. Campbell, K. Almeroth, B. Bimber, D. Chun and A. Knight, "[Overestimation Bias in Self-reported SAT Scores](#)," Educational Psychology Review, vol. 19, num. 4, pp. 443-454, December 2007.
33. P. Namburi, K. Sarac and K. Almeroth, "[Practical Utilities for Monitoring Multicast Service Availability](#)," Computer Communications Special Issue on Monitoring and Measurement of IP Networks, vol. 29, num. 10, pp. 1675-1686, June 2006.
32. R. Chalmers, G. Krishnamurthi and K. Almeroth, "[Enabling Intelligent Handovers in Heterogeneous Wireless Networks](#)," ACM Journal on Mobile Networks and Applications (MONET), vol. 11, num. 2, pp. 215-227, April 2006.
31. H. Lundgren, K. Ramachandran, E. Belding, K. Almeroth, M. Benny, A. Hewatt, A. Touma and A. Jardosh, "[Experience from the Design, Deployment and Usage of the UCSB MeshNet Testbed](#)," IEEE Wireless Communications, vol. 13, num. 2, pp. 18-29, April 2006.
30. R. Mayer, K. Almeroth, B. Bimber, D. Chun, A. Knight and A. Campbell, "[Technology Comes to College: Understanding the Cognitive Consequences of Infusing Technology in College Classrooms](#)," Educational Technology, vol. 46, num. 2, pp. 48-53, March-April 2006.
29. A. Garyfalos and K. Almeroth, "[A Flexible Overlay Architecture for Mobile IPv6 Multicast](#)," Journal on Selected Areas in Communications (JSAC) Special Issue on Wireless Overlay Networks Based on Mobile IPv6, vol. 23, num. 11, pp. 2194-2205, November 2005.
28. K. Sarac and K. Almeroth, "[Monitoring IP Multicast in the Internet: Recent Advances and Ongoing Challenges](#)," IEEE Communications, vol. 43, num. 10, pp. 85-91, October 2005.
27. K. Sarac and K. Almeroth, "[Application Layer Reachability Monitoring for IP Multicast](#)," Computer Networks, vol. 48, num. 2, pp. 195-213, June 2005.
26. A. Jardosh, E. Belding, K. Almeroth and S. Suri, "[Real-world Environment Models for Mobile Network Evaluation](#)," Journal on Selected Areas in Communications Special Issue on Wireless Ad hoc Networks, vol. 23, num. 3, pp. 622-632, March 2005.
25. S. Rollins and K. Almeroth, "[Evaluating Performance Tradeoffs in a One-to-Many Peer Content Distribution Architecture](#)," Journal of Internet Technology, vol. 5, num. 4, pp. 373-387, Fall 2004.
24. K. Sarac and K. Almeroth, "[Tracetree: A Scalable Mechanism to Discover Multicast Tree Topologies in the Network](#)," IEEE/ACM Transactions on Networking, vol. 12, num. 5, pp. 795-808, October 2004.
23. K. Sarac and K. Almeroth, "[A Distributed Approach for Monitoring Multicast Service Availability](#)," Journal of Network and Systems Management, vol. 12, num. 3, pp. 327-348, September 2004.
22. P. Rajvaidya, K. Ramachandran and K. Almeroth, "[Managing and Securing the Global Multicast Infrastructure](#)," Journal of Network and Systems Management, vol. 12, num. 3, pp. 297-326, September 2004.
21. P. Rajvaidya and K. Almeroth, "[Multicast Routing Instabilities](#)," IEEE Internet Computing, vol. 8, num. 5, pp. 42-49, September/October 2004.
20. D. Johnson, R. Patton, B. Bimber, K. Almeroth and G. Michaels, "[Technology and Plagiarism in the University: Brief Report of a Trial in Detecting Cheating](#)," Association for the Advancement of Computing in Education (AACE) Journal, vol. 12, num. 3, pp. 281-299, Summer 2004.

19. R. Chalmers and K. Almeroth, "[A Security Architecture for Mobility-Related Services](#)," *Journal of Wireless Personal Communications*, vol 29, num. 3, pp. 247-261, June 2004.
18. B. Stiller, K. Almeroth, J. Altmann, L. McKnight, and M. Ott, "[Pricing for Content in the Internet](#)," *Computer Communications*, vol. 27, num. 6, pp. 522-528, April 2004.
17. S. Rollins and K. Almeroth, "[Lessons Learned Deploying a Digital Classroom](#)," *Journal of Interactive Learning Research (JILR)*, vol. 15, num. 2, pp. 169-185, April 2004.
16. S. Jagannathan and K. Almeroth, "[A Dynamic Pricing Scheme for E-Content at Multiple Levels-of-Service](#)," *Computer Communications*, vol. 27, num. 4, pp. 374-385, March 2004.
15. K. Almeroth, "[Using Satellite Links in the Delivery of Terrestrial Multicast Traffic](#)," *Internetworking and Computing over Satellites*, Kluwer Academic Publishers, 2003.
14. R. Chalmers and K. Almeroth, "[On the Topology of Multicast Trees](#)," *IEEE/ACM Transactions on Networking*, vol. 11, num. 1, pp. 153-165, January 2003.
13. S. Jagannathan, J. Nayak, K. Almeroth, and M. Hofmann, "[On Pricing Algorithms for Batched Content Delivery Systems](#)," *Electronic Commerce Research and Applications Journal*, vol. 1, num. 3-4, pp. 264-280, Fall 2002.
12. D. Makofske and K. Almeroth, "[Multicast Sockets: Practical Guide for Programmers](#)," *Morgan Kaufmann Publishers*, November 2002.
11. S. Jagannathan and K. Almeroth, "[Price Issues in Delivering E-Content On-Demand](#)," *ACM Sigecom Exchanges*, vol. 3, num. 2, pp. 18-27, May 2002.
10. D. Makofske and K. Almeroth, "[From Television to Internet Video-on-Demand: Techniques and Tools for VCR-Style Interactivity](#)," *Software: Practice and Experience*, vol. 31, num. 8, pp. 781-801, July 2001.
9. K. Sarac and K. Almeroth, "[Supporting Multicast Deployment Efforts: A Survey of Tools for Multicast Monitoring](#)," *Journal on High Speed Networking*, Special Issue on Management of Multimedia Networking, vol. 9, num. 3/4, pp. 191-211, March 2001.
8. K. Almeroth, "[Adaptive, Workload-Dependent Scheduling for Large-Scale Content Delivery Systems](#)," *Transactions on Circuits and Systems for Video Technology*, *Special Issue on Streaming Video*, vol. 11, num. 3, pp. 426-439, March 2001.
7. D. Makofske and K. Almeroth, "[Real-Time Multicast Tree Visualization and Monitoring](#)," *Software: Practice and Experience*, vol. 30, num. 9, pp. 1047-1065, July 2000.
6. M. Ammar, K. Almeroth, R. Clark and Z. Fei, "Multicast Delivery of WWW Pages," *Electronic Commerce Technology Trends: Challenges and Opportunities*, IBM Press, February 2000.
5. K. Almeroth, "[The Evolution of Multicast: From the MBone to Inter-Domain Multicast to Internet2 Deployment](#)," *IEEE Network Special Issue on Multicasting*, vol. 10, num. 1, pp. 10-20, January/February 2000.
4. K. Almeroth and M. Ammar, "[An Alternative Paradigm for Scalable On-Demand Applications: Evaluating and Deploying the Interactive Multimedia Jukebox](#)," *IEEE Transactions on Knowledge and Data Engineering Special Issue on Web Technologies*, vol. 11, num. 4, pp. 658-672, July/August 1999.

3. K. Almeroth and M. Ammar, "[The Interactive Multimedia Jukebox \(IMJ\): A New Paradigm for the On-Demand Delivery of Audio/Video](#)," *Computer Networks and ISDN Systems*, vol. 30, no. 1, April 1998.
2. K. Almeroth and M. Ammar, "[Multicast Group Behavior in the Internet's Multicast Backbone \(MBone\)](#)," *IEEE Communications*, vol. 35, no. 6, pp. 124-129, June 1997.
1. K. Almeroth and M. Ammar, "[On the Use of Multicast Delivery to Provide a Scalable and Interactive Video-on-Demand Service](#)," *Journal on Selected Areas of Communication (JSAC)*, vol. 14, no. 6, pp. 1110-1122, August 1996.

B. Conference Papers with Proceedings (refereed)

89. D. Havey and K. Almeroth, "[Active Sense Queue Management \(ASQM\)](#)," *IFIP Networking Conference*, Toulouse, FRANCE, May 2015.
88. L. Deek, E. Garcia-Villegas, E. Belding, S.J. Lee, and K. Almeroth, "[Joint Rate and Channel Width Adaptation in 802.11 MIMO Wireless Networks](#)," *IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, New Orleans, LA, USA, June 2013.
87. D. Havey and K. Almeroth, "[Fast Wireless Protocol: A Network Stack Design for Wireless Transmission](#)," *IFIP Networking Conference*, Brooklyn, New York, USA, May 2013.
86. M. Tavakolifard, J. Gulla, K. Almeroth, J. Ingvaldsen, G. Nygreen, and E. Berg, "[Tailored News in the Palm of Your HAND: A Multi-Perspective Transparent Approach to News Recommendation](#)," *Demo Track at the International World Wide Web Conference (WWW)*, Rio de Janeiro, BRAZIL, May 2013.
85. S. Patterson, M. Wittie, K. Almeroth, and B. Bamieh, "[Network Optimization with Dynamic Demands and Link Prices](#)," *Allerton Conference*, Monticello, Illinois, USA, October 2012.
84. D. Havey, R. Chertov, and K. Almeroth, "[Receiver Driven Rate Adaptation](#)," *ACM Multimedia Systems Conference (MMSys)*, Chapel Hill, North Carolina, USA, February 2012.
83. M. Tavakolifard and K. Almeroth, "[Trust 2.0: Who to Believe in the Flood of Online Data?](#)" *International Conference on Computing, Networking and Communications (ICNC)*, Maui, Hawaii, USA, January 2012.
82. L. Deek, E. Garcia-Villegas, E. Belding, S.J. Lee, and K. Almeroth, "[The Impact of Channel Bonding on 802.11n Network Management](#)," *ACM CoNEXT*, Tokyo, JAPAN, December 2011.
81. L. Deek, X. Zhou, K. Almeroth, and H. Zheng, "[To Preempt or Not: Tackling Bid and Time-based Cheating in Online Spectrum Auctions](#)," *IEEE Infocom*, Shanghai, CHINA, April 2011.
80. M. Wittie, V. Pejovic, L. Deek, K. Almeroth, and B. Zhao, "[Exploiting Locality of Interest in Online Social Networks](#)," *ACM CoNEXT*, Philadelphia, Pennsylvania, USA, November 2010.
79. R. Chertov and K. Almeroth, "[Using BGP in a Satellite-Based Challenged Network Environment](#)," *IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, Boston, Massachusetts, USA, June 2010.
78. R. Chertov, D. Havey and K. Almeroth, "[MSET: A Mobility Satellite Emulation Testbed](#)," *IEEE Zoom Communication*, Inc. Ex 1015

Infocom, San Diego, California, USA, March 2010.

77. B. Stone-Gross, A. Moser, C. Kruegel, E. Kirda, and K. Almeroth, "[FIRE: Finding Rogue nEtworks](#)," *Annual Computer Security Applications Conference (ACSAC)*, Honolulu, Hawaii, USA, December 2009.
76. M. Wittie, K. Almeroth, E. Belding, I. Rimal, and V. Hilt, "[Internet Service in Developing Regions Through Network Coding](#)," *IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, Rome, ITALY, June 2009.
75. R. Chertov and K. Almeroth, "[High-Fidelity Link Shaping](#)," *International Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities (TRIDENTCOM)*, Washington DC, USA, April 2009.
74. L. Deek, K. Almeroth, M. Wittie, and K. Harras, "[Exploiting Parallel Networks Using Dynamic Channel Scheduling](#)," *International Wireless Internet Conference (WICON)*, Maui, Hawaii, USA, November 2008.
73. D. Havey, E. Barlas, R. Chertov, K. Almeroth, and E. Belding, "[A Satellite Mobility Model for QUALNET Network Simulations](#)," *IEEE Military Communications Conference (MILCOM)*, San Diego, California, USA, November 2008.
72. J. Kayfetz and K. Almeroth, "[Creating Innovative Writing Instruction for Computer Science Graduate Students](#)," *ASEE/IEEE Frontiers in Education (FIE) Conference*, Saratoga Springs, New York, USA, October 2008.
71. G. Swamynathan, B. Zhao, K. Almeroth, and S. Rao, "[Towards Reliable Reputations for Dynamic Networked Systems](#)," *IEEE International Symposium on Reliable Distributed Systems (SRDS)*, Napoli, ITALY, October 2008.
70. B. Stone-Gross, D. Sigal, R. Cohn, J. Morse, K. Almeroth, and C. Kruegel, "[VeriKey: A Dynamic Certificate Verification System for Public Key Exchanges](#)," *Conference on Detection of Intrusions and Malware & Vulnerability Assessment (DIMVA)*, Paris, FRANCE, July 2008.
69. P. Acharya, A. Sharma, E. Belding, K. Almeroth, K. Papagiannaki, "[Congestion-Aware Rate Adaptation in Wireless Networks: A Measurement-Driven Approach](#)," *IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, San Francisco, California, USA, June 2008.
68. A. Jardosh, P. Suwannat, T. Hollerer, E. Belding, and K. Almeroth, "[SCUBA: Focus and Context for Real-time Mesh Network Health Diagnosis](#)," *Passive and Active Measurement Conference (PAM)*, Cleveland, Ohio, USA, April 2008.
67. B. Stone-Gross, C. Wilson, K. Almeroth, E. Belding, H. Zheng, K. Papagiannaki, "[Malware in IEEE 802.11 Wireless Networks](#)," *Passive and Active Measurement Conference (PAM)*, Cleveland, Ohio, USA, April 2008.
66. R. Raghavendra, E. Belding, K. Papagiannaki, and K. Almeroth, "[Understanding Handoffs in Large IEEE 802.11 Wireless Networks](#)," *Internet Measurement Conference (IMC)*, San Diego, California, USA, October 2007.
65. M. Wittie, B. Stone-Gross, K. Almeroth and E. Belding, "[MIST: Cellular Data Network Measurement for Mobile Applications](#)," *IEEE International Conference on Broadband Communications, Networks, and Services (BROADNETS)*, San Francisco, California, USA, October 2008.

and Systems (BroadNets), Raleigh, North Carolina, USA, September 2007.

64. S. Karpinski, E. Belding, K. Almeroth, "[Wireless Traffic: The Failure of CBR Modeling](#)," *IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets)*, Raleigh, North Carolina, USA, September 2007.
63. A. Knight, K. Almeroth, H. Zhang, R. Mayer, and K. DeLeeuw, "[Data Cafe: A Dining Car Approach to Educational Research Data Management and Distribution](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Vancouver, CANADA, June 2007.
62. H. Zhang, K. Almeroth, A. Knight, M. Bulger, and R. Mayer, "[Moodog: Tracking Students' Online Learning Activities](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Vancouver, CANADA, June 2007.
61. M. Bulger, K. Almeroth, R. Mayer, D. Chun, A. Knight, H. Collins, "[Effects of Instructor Engagement on Student Use of a Course Management System](#)," Association for Psychological Science (APS) Annual Conference, Washington DC, USA, May 2007.
60. R. Mayer, A. Stull, K. Almeroth, B. Bimber, D. Chun, M. Bulger, J. Campbell, Allan Knight, and H. Zhang, "[Using Technology-Based Methods to Foster Learning in Large Lecture Classes: Evidence for the Pedagogic Value of Clickers](#)," *American Educational Research Association (AERA) Annual Conference*, Chicago, Illinois, USA, April 2007.
59. K. Ramachandran, I. Sheriff, E. Belding, and K. Almeroth, "[Routing Stability in Static Wireless Mesh Networks](#)," *Passive and Active Measurement Conference (PAM)*, Louvain-la-neuve, BELGIUM, April 2007.
58. G. Swamynathan, T. Close, S. Banerjee, R. McGeer, B. Zhao, and K. Almeroth, "[Scalable Access Control For Web Services](#)," *International Conference on Creating, Connecting and Collaborating through Computing (C5)*, Kyoto, JAPAN, January 2007.
57. A. Knight, M. Bulger, K. Almeroth, and H. Zhang, "[Is Learning Really a Phone Call Away? Knowledge Transfer in Mobile Learning](#)," *World Conference on Mobile Learning (mLearn)*, Banff, Alberta, CANADA, October 2006.
56. J. Kurian, K. Sarac, and K. Almeroth, "[Defending Network-Based Services Against Denial of Service Attacks](#)," *International Conference on Computer Communication and Networks (IC3N)*, Arlington, Virginia, USA, October 2006.
55. A. Jardosh, K. Sanzgiri, E. Belding and K. Almeroth, "[IQU: Practical Queue-Based User Association Management for WLANs--Case Studies, Architecture, and Implementation](#)," *ACM Mobicom*, Marina del Rey, California, USA, September 2006.
54. C. Holman, K. Harras, and K. Almeroth, "[A Proactive Data Bundling System for Intermittent Mobile Connections](#)," *IEEE International Conference on Sensor and Ad Hoc Communications and Networks (SECON)*, Reston, Virginia, USA, September 2006.
53. G. Banks, M. Cova, V. Felmetsger, K. Almeroth, R. Kemmerer and G. Vigna, "[SNOOZE: toward a Stateful NetwOrk prOtocol fuzZEr](#)," *Information Security Conference (ISC)*, Samos Island, GREECE, September 2006.
52. K. Harras and K. Almeroth, "[Inter-Regional Messenger Scheduling in Delay Tolerant Mobile Networks](#)," *IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks*

(WoWMoM), Niagara Falls, New York, USA, June 2006.

51. M. Bulger, R. Mayer, and K. Almeroth, "[Engaged By Design: Using Simulation to Promote Active Learning](#)," **Outstanding Paper** at the *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Orlando, Florida, USA, June 2006.
50. A. Knight, K. Almeroth, R. Mayer, D. Chun, and B. Bimber, "[Observations and Recommendations for Using Technology to Extend Interaction](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Orlando, Florida, USA, June 2006.
49. H. Zhang, and K. Almeroth, "[A Simple Classroom Network Access Control System](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Orlando, Florida, USA, June 2006.
48. K. Harras and K. Almeroth, "[Transport Layer Issues in Delay Tolerant Mobile Networks](#)," *IFIP Networking Conference*, Coimbra, PORTUGAL, May 2006.
47. R. Mayer, A. Stull, J. Campbell, K. Almeroth, B. Bimber, D. Chun and A. Knight, "[Some Shortcomings of Soliciting Students' Self-Reported SAT Scores](#)," *American Educational Research Association (AERA) Annual Conference*, San Francisco, California, USA, April 2006.
46. K. Ramachandran, E. Belding, K. Almeroth, and M. Buddhikot, "[Interference-Aware Channel Assignment in Multi-Radio Wireless Mesh Networks](#)," *IEEE Infocom*, Barcelona, SPAIN, April 2006.
45. A. Jardosh, K. Ramachandran, K. Almeroth, and E. Belding, "[Understanding Congestion in IEEE 802.11b Wireless Networks](#)," *ACM/USENIX Internet Measurement Conference (IMC)*, Berkeley, California, USA, October 2005.
44. H. Zhang, K. Almeroth and M. Bulger, "[An Activity Monitoring System to Support Classroom Research](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Montreal, Quebec, CANADA, pp. 1444-1449, June 2005.
43. Z. Xiang, H. Zhang, J. Huang, S. Song and K. Almeroth, "[A Hidden Environment Model for Constructing Indoor Radio Maps](#)," *IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM)*, Taormina, ITALY, June 2005.
42. K. Harras, K. Almeroth and E. Belding, "[Delay Tolerant Mobile Networks \(DTMNs\): Controlled Flooding in Sparse Mobile Networks](#)," *IFIP Networking Conference*, Waterloo, Ontario, CANADA, May 2005.
41. A. Garyfalos and K. Almeroth, "[Coupons: Wide Scale Information Distribution for Wireless Ad Hoc Networks](#)," *IEEE Global Telecommunications Conference (Globecom) Global Internet and Next Generation Networks Symposium*, Dallas, Texas, USA, pp. 1655-1659, December 2004.
40. A. Knight and K. Almeroth, "[DeCAF: A Digital Classroom Application Framework](#)," *IASTED International Conference on Communications, Internet and Information Technology (CIIT)*, St. Thomas, US Virgin Islands, November 2004.
39. P. Namburi, K. Sarac and K. Almeroth, "[SSM-Ping: A Ping Utility for Source Specific Multicast](#)," *IASTED International Conference on Communications, Internet and Information Technology (CIIT)*, St. Thomas, US Virgin Islands, November 2004.
38. K. Ramachandran, E. Belding and K. Almeroth, "[DAMON: A Distributed Architecture for Monitoring](#)

[Multi-hop Mobile Networks](#)," *IEEE International Conference on Sensor and Ad Hoc Communications and Networks (SECON)*, Santa Clara, California, USA, October 2004.

37. A. Garyfalos and K. Almeroth, "[Coupon Based Incentive Systems and the Implications of Equilibrium Theory](#)," *IEEE Conference on Electronic Commerce (CEC)*, San Diego, California, USA, pp. 213-220, July 2004.
36. A. Knight, K. Almeroth and B. Bimber, "[An Automated System for Plagiarism Detection Using the Internet](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Lugano, Switzerland, pp. 3619-3625, June 2004.
35. H. Zhang and K. Almeroth, "[Supplement to Distance Learning: Design for a Remote TA Support System](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Lugano, Switzerland, pp. 2821-2830, June 2004.
34. U. Mohan, K. Almeroth and E. Belding, "[Scalable Service Discovery in Mobile Ad hoc Networks](#)," *IFIP Networking Conference*, Athens, Greece, pp. 137-149, May 2004.
33. V. Thanedar, K. Almeroth and E. Belding, "[A Lightweight Content Replication Scheme for Mobile Ad hoc Environments](#)," *IFIP Networking Conference*, Athens, Greece, pp. 125-136, May 2004.
32. R. Chalmers and K. Almeroth, "[A Mobility Gateway for Small-Device Networks](#)," *IEEE International Conference on Pervasive Computing and Communications (PerCom)*, Orlando, Florida, USA, March 2004.
31. A. Jardosh, E. Belding, K. Almeroth and S. Suri, "[Towards Realistic Mobility Models For Mobile Ad hoc Networks](#)," *ACM Mobicom*, San Diego, California, USA, September 2003.
30. K. Sarac, P. Namburi and K. Almeroth, "[SSM Extensions: Network Layer Support for Multiple Senders in SSM](#)," *International Conference on Computer Communication and Networks (IC3N)*, Dallas, Texas, USA, October 2003.
29. K. Ramachandran and K. Almeroth, "[MAFIA: A Multicast Management Solution for Access Control and Traffic Filtering](#)," *IEEE/IFIP Conference on Management of Multimedia Networks and Services (MMNS)*, Belfast, Northern Ireland, September 2003.
28. J. Humfrey, S. Rollins, K. Almeroth, and B. Bimber, "[Managing Complexity in a Networked Learning Environment](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Honolulu, Hawaii, USA, pp. 60-63, June 2003.
27. K. Almeroth, S. Rollins, Z. Shen, and B. Bimber, "[Creating a Demarcation Point Between Content Production and Encoding in a Digital Classroom](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Honolulu, Hawaii, USA, pp. 2-5, June 2003.
26. M. Kolsch, K. Kvilekval, and K. Almeroth, "[Improving Speaker Training with Interactive Lectures](#)," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Honolulu, Hawaii, USA, June 2003.
25. P. Rajvaidya and K. Almeroth, "[Analysis of Routing Characteristics in the Multicast Infrastructure](#)," *IEEE Infocom*, San Francisco, California, USA, April 2003.
24. S. Rollins and K. Almeroth, "[Pixie: A Jukebox Architecture to Support Efficient Peer Content Exchange](#)," *ACM Multimedia*, Juan Les Pins, FRANCE, December 2002.

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23. S. Rollins, R. Chalmers, J. Blanquer, and K. Almeroth, "[The Active Information System\(AIS\): A Model for Developing Scalable Web Services](#)," *IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA)*, Kauai, Hawaii, USA, August 2002.
22. S. Rollins and K. Almeroth, "[Seminal: Additive Semantic Content for Multimedia Streams](#)," *IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA)*, Kauai, Hawaii, USA, August 2002.
21. B. Stiller, K. Almeroth, J. Altmann, L. McKnight, and M. Ott, "[Content Pricing in the Internet](#)," *SPIE ITCOM Conference on Internet Performance and Control of Network Systems (IPCNS)*, Boston, Massachusetts, USA, July 2002.
20. S. Jagannathan, J. Nayek, K. Almeroth and M. Hofmann, "[A Model for Discovering Customer Value for E-Content](#)," *ACM International Conference on Knowledge Discovery and Data Mining (SIGKDD)*, Edmonton, Alberta, CANADA, July 2002.
19. S. Rollins and K. Almeroth, "[Deploying and Infrastructure for Technologically Enhanced Learning](#)," **Outstanding Paper** at the *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Denver, Colorado, USA, pp. 1651-1656, June 2002.
18. P. Rajvaidya and K. Almeroth, "[Building the Case for Distributed Global Multicast Monitoring](#)," *Multimedia Computing and Networking (MMCN)*, San Jose, California, USA, January 2002.
17. S. Jagannathan and K. Almeroth, "[An Adaptive Pricing Scheme for Content Delivery Systems](#)," *IEEE Global Internet*, San Antonio, Texas, USA, November 2001.
16. K. Sarac and K. Almeroth, "[Providing Scalable Many-to-One Feedback in Multicast Reachability Monitoring Systems](#)," *IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS)*, Chicago, Illinois, USA, October 2001.
15. S. Jagannathan and K. Almeroth, "[The Dynamics of Price, Revenue and System Utilization](#)," *IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS)*, Chicago, Illinois, USA, October 2001.
14. A. Kanwar, K. Almeroth, S. Bhattacharyya, and M. Davy, "[Enabling End-User Network Monitoring via the Multicast Consolidated Proxy Monitor](#)," *SPIE ITCOM Conference on Scalability and Traffic Control in IP Networks (STCIPN)*, Denver, Colorado, USA, August 2001.
13. S. Jagannathan and K. Almeroth, "[Using Tree Topology for Multicast Congestion Control](#)," *International Conference on Parallel Processing (ICPP)*, Valencia, SPAIN, September 2001.
12. P. Rajvaidya and K. Almeroth, "[A Router-Based Technique for Monitoring the Next-Generation of Internet Multicast Protocols](#)," *International Conference on Parallel Processing (ICPP)*, Valencia, SPAIN, September 2001.
11. R. Chalmers and K. Almeroth, "[Modeling the Branching Characteristics and Efficiency Gains of Global Multicast Trees](#)," *IEEE Infocom*, Anchorage, Alaska, USA, April 2001.
10. R. Chalmers and K. Almeroth, "[Developing a Multicast Metric](#)," *Global Internet*, San Francisco, California, USA, December 2000.
9. K. Sarac and K. Almeroth, "[Monitoring Reachability in the Global Multicast Infrastructure](#)," *IEEE International Conference on Network Protocols (ICNP)*, Osaka, JAPAN, November 2000.

8. K. Almeroth, "[A Long-Term Analysis of Growth and Usage Patterns in the Multicast Backbone \(MBone\)](#)," *IEEE INFOCOM*, Tel Aviv, ISRAEL, March 2000.
7. K. Almeroth, K. Obraczka and D. De Lucia, "[A Lightweight Protocol for Interconnecting Heterogeneous Devices in Dynamic Environments](#)," *IEEE International Conference on Multimedia Computing and Systems (ICMCS)*, Florence, ITALY, June 1999.
6. K. Almeroth and M. Ammar, "[The Interactive Multimedia Jukebox \(IMJ\): A New Paradigm for the On-Demand Delivery of Audio/Video](#)," **Best Paper** at the *Seventh International World Wide Web Conference (WWW)*, Brisbane, AUSTRALIA, April 1998.
5. K. Almeroth, M. Ammar and Z. Fei, "[Scalable Delivery of Web Pages Using Cyclic Best-Effort \(UDP\) Multicast](#)," *IEEE INFOCOM*, San Francisco, California, USA, June 1998.
4. K. Almeroth and M. Ammar, "[Delivering Popular Web Pages Using Cyclic Unreliable Multicast \(Extended Abstract\)](#)," *SPIE Conference on Voice, Video and Data Communications*, Dallas, Texas, USA, November 1997.
3. K. Almeroth, A. Dan, D. Sitaram and W. Tetzlaff, "[Long Term Resource Allocation in Video Delivery Systems](#)," *IEEE INFOCOM*, Kobe, JAPAN, April 1997.
2. K. Almeroth and M. Ammar, "[On the Performance of a Multicast Delivery Video-On-Demand Service with Discontinuous VCR Actions](#)," *International Conference on Communications (ICC)*, Seattle, Washington, USA, June 1995.
1. K. Almeroth and M. Ammar, "[A Scalable, Interactive Video-On-Demand Service Using Multicast Communication](#)," *International Conference on Computer Communication and Networks (IC3N)*, San Francisco, California, USA, September 1994.

C. Workshop Papers (refereed)

34. M. Tavakolifard, J. Gulla, K. Almeroth, F. Hopfgartner, B. Kille, T. Plumbaum, A. Lommatzsch, T. Brodt, A. Bucko, and T. Heintz, "[Workshop and Challenge on News Recommender Systems](#)," *ACM RecSys News Recommender Systems (NRS) Workshop and Challenge*, Hong Kong, CHINA, October 2013.
33. M. Tavakolifard, K. Almeroth, and J. Gulla, "[Does Social Contact Matter? Modelling the Hidden Web of Trust Underlying Twitter](#)," *ACM International Workshop on Social Recommender Systems (SRS)*, Rio de Janeiro, BRAZIL, May 2013.
32. D. Johnson, E. Belding, K. Almeroth and G. van Stam, "[Internet Usage and Performance Analysis of a Rural Wireless Network in Macha, Zambia](#)," *ACM Networked Systems for Developing Regions (NSDR) Workshop*, San Francisco, California, USA, June 2010.
31. D. Havey, R. Chertov, and K. Almeroth, "[Wired Wireless Broadcast Emulation](#)," *International Workshop on Wireless Network Measurement (WiNMee)*, Seoul, Korea, June 2009.
30. R. Raghavendra, P. Acharya, E. Belding, and K. Almeroth, "[MeshMon: A Multi-Tiered Framework for Wireless Mesh Network Monitoring](#)," *ACM Mobihoc Wireless of the Students, by the Students, for the Students Workshop (S3)*, New Orleans, Louisiana, USA, May 2009.

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29. G. Swamynathan, C. Wilson, B. Boe, B. Zhao, and K. Almeroth, "[Do Social Networks Improve e-Commerce: A Study on Social Marketplaces](#)," *ACM Sigcomm Workshop on Online Social Networks (WOSN)*, Seattle, Washington, USA, August 2008.
28. R. Raghavendra, E. Belding, and K. Almeroth, "[Antler: A Multi-Tiered Approach to Automated Wireless Network Management](#)," *IEEE Workshop on Automated Network Management (ANM)*, Phoenix, Arizona, USA, April 2008.
27. S. Karpinski, E. Belding, and K. Almeroth, "[Towards Realistic Models of Wireless Workload](#)," *International Workshop on Wireless Network Measurement (WiNMee)*, Limassol, CYPRUS, April 2007.
26. K. Harras, M. Wittie, K. Almeroth, and E. Belding, "[ParaNets: A Parallel Network Architecture for Challenged Networks](#)," *IEEE Workshop on Mobile Computing Systems and Applications (HotMobile)*, Tucson, Arizona, USA, February 2007.
25. H. Caituiro-Monge, K. Almeroth, M. del Mar Alvarez-Rohena, "[Friend Relay: A Resource Sharing Framework for Mobile Wireless Devices](#)," *ACM International Workshop on Wireless Mobile Applications and Services on WLAN Hotspots (WMASH)*, Los Angeles, California, September 2006.
24. G. Swamynathan, Ben Y. Zhao and K. Almeroth, "[Exploring the Feasibility of Proactive Reputations](#)," *International Workshop on Peer-to-Peer Systems (IPTPS)*, Santa Barbara, California, USA, February 2006.
23. G. Swamynathan, Ben Y. Zhao and K. Almeroth, "[Decoupling Service and Feedback Trust in a Peer-to-Peer Reputation System](#)," *International Workshop on Applications and Economics of Peer-to-Peer Systems (AEPP)*, Nanjing, CHINA, November 2005.
22. K. Ramachandran, M. Buddhikot, G. Chandranmenon, S. Miller, E. Belding, and K. Almeroth, "[On the Design and Implementation of Infrastructure Mesh Networks](#)," *IEEE Workshop on Wireless Mesh Networks (WiMesh)*, Santa Clara, California, USA, September 2005.
21. A. Jardosh, K. Ramachandran, K. Almeroth and E. Belding, "[Understanding Link-Layer Behavior in Highly Congested IEEE 802.11b Wireless Networks](#)," *Sigcomm Workshop on Experimental Approaches to Wireless Network Design and Analysis (EWIND)*, Philadelphia, Pennsylvania, USA, August 2005.
20. A. Sen Mazumder, K. Almeroth and K. Sarac, "[Facilitating Robust Multicast Group Management](#)," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)*, Skamania, Washington, USA, June 2005.
19. Y. Sun, I. Sheriff, E. Belding and K. Almeroth, "[An Experimental Study of Multimedia Traffic Performance in Mesh Networks](#)," *MobiSys International Workshop on Wireless Traffic Measurements and Modeling (WitMeMo)*, Seattle, Washington, USA, June 2005.
18. K. Ramachandran, K. Almeroth and E. Belding, "[A Framework for the Management of Large-Scale Wireless Network Testbeds](#)," *International Workshop on Wireless Network Measurement (WiNMee)*, Trentino, ITALY, April 2005.
17. A. Garyfalos, K. Almeroth and K. Sanzgiri, "[Deployment Complexity Versus Performance Efficiency in Mobile Multicast](#)," *International Workshop on Broadband Wireless Multimedia: Algorithms, Architectures and Applications (BroadWiM)*, San Jose, California, USA, October 2004.

16. C. Ho, K. Ramachandran, K. Almeroth and E. Belding, "[A Scalable Framework for Wireless Network Monitoring](#)," *ACM International Workshop on Wireless Mobile Applications and Services on WLAN Hotspots (WMASH)*, Philadelphia, Pennsylvania, USA, October 2004.
15. A. Garyfalos, K. Almeroth and J. Finney, "[A Hybrid of Network and Application Layer Multicast for Mobile IPv6 Networks](#)," *International Workshop on Large-Scale Group Communication (LSGC)*, Florence, ITALY, October 2003.
14. A. Garyfalos, K. Almeroth and J. Finney, "[A Comparison of Network and Application Layer Multicast for Mobile IPv6 Networks](#)," *ACM Workshop on Modeling, Analysis and Simulation of Wireless and Mobile Systems (MSWiM)*, San Diego, California, USA, September 2003.
13. S. Jagannathan, and K. Almeroth, "[Pricing and Resource Provisioning for Delivering E-Content On-Demand with Multiple Levels-of-Service](#)," *International Workshop on Internet Charging and QoS Technologies (ICQT)*, Zurich, SWITZERLAND, October 2002.
12. S. Rollins, K. Almeroth, D. Milojevic, and K. Nagaraja, "[Power-Aware Data Management for Small Devices](#)," *Workshop on Wireless Mobile Multimedia (WoWMoM)*, Atlanta, GA, USA, September 2002.
11. K. Almeroth, S. Bhattacharyya, and C. Diot, "[Challenges of Integrating ASM and SSM IP Multicast Protocol Architectures](#)," *International Workshop on Digital Communications: Evolutionary Trends of the Internet (IWDC)*, Taormina, ITALY, September 2001.
10. K. Sarac and K. Almeroth, "[Scalable Techniques for Discovering Multicast Tree Topology](#)," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)*, Port Jefferson, New York, USA, June 2001.
9. P. Rajvaidya, K. Almeroth and K. Claffy, "[A Scalable Architecture for Monitoring and Visualizing Multicast Statistics](#)," *IFIP/IEEE International Workshop on Distributed Systems: Operations & Management (DSOM)*, Austin, Texas, USA, December 2000.
8. S. Jagannathan, K. Almeroth and A. Acharya, "[Topology Sensitive Congestion Control for Real-Time Multicast](#)," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)*, Chapel Hill, North Carolina, USA, June 2000.
7. K. Sarac and K. Almeroth, "[Supporting the Need for Inter-Domain Multicast Reachability](#)," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)*, Chapel Hill, North Carolina, USA, June 2000.
6. D. Makofske and K. Almeroth, "[MHealth: A Real-Time Multicast Tree Visualization and Monitoring Tool](#)," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)*, Basking Ridge New Jersey, USA, June 1999.
5. K. Almeroth and Y. Zhang, "[Using Satellite Links as Delivery Paths in the Multicast Backbone \(MBone\)](#)," *ACM/IEEE International Workshop on Satellite-Based Information Services (WOSBIS)*, Dallas, Texas, USA, October 1998.
4. M. Ammar, K. Almeroth, R. Clark and Z. Fei, "[Multicast Delivery of Web Pages OR How to Make Web Servers Pushy](#)," *Workshop on Internet Server Performance (WISP)*, Madison, Wisconsin, USA, June 1998.
3. K. Almeroth and M. Ammar, "[Prototyping the Interactive Multimedia Jukebox](#)," *Mini-conference on Multimedia Appliances, Interfaces, and Trials--International Conference on Communications (ICC)*, Zoom Communication, Inc. Ex 1015

Montreal, Quebec, CANADA, June 1997.

2. K. Almeroth and M. Ammar, "[Collection and Modeling of the Join/Leave Behavior of Multicast Group Members in the Mbone](#)," *High Performance Distributed Computing Focus Workshop (HPDC)*, Syracuse, New York, USA, August 1996.
1. K. Almeroth and M. Ammar, "[The Role of Multicast Communication in the Provision of Scalable and Interactive Video-On-Demand Service](#)," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)*, Durham, New Hampshire, USA, April 1995.

D. Non-Refereed Publications

8. K. Almeroth, E. Belding, M. Buddhikot, G. Chandranmenon, S. Miller, and K. Ramachandran, "[Infrastructure Mesh Networks](#)," *U.S. Patent Application US20070070959 A1*, September 2005.
7. K. Almeroth, R. Caceres, A. Clark, R. Cole, N. Duffield, T. Friedman, K. Hedayat, K. Sarac, M. Westerlund, "[RTP Control Protocol Extended Reports \(RTCP XR\)](#)," *Internet Engineering Task Force (IETF) Request for Comments (RFC) 3611*, November 2003.
6. Z. Albanna, K. Almeroth, D. Meyer, and M. Schipper, "[IANA Guidelines for IPv4 Multicast Address Allocation](#)," *Internet Engineering Task Force (IETF) Request for Comments (RFC) 3171*, August 2001.
5. B. Quinn and K. Almeroth, "[IP Multicast Applications: Challenges and Solutions](#)," *Internet Engineering Task Force (IETF), Request for Comments (RFC) 3170*, September 2001.
4. K. Almeroth, L. Wei and D. Farinacci, "[Multicast Reachability Monitor \(MRM\) Protocol](#)," *Internet Engineering Task Force Internet Draft*, July 2000.
3. K. Almeroth and L. Wei, "[Justification for and use of the Multicast Reachability Monitor \(MRM\) Protocol](#)," *Internet Engineering Task Force Internet Draft*, March 1999.
2. K. Almeroth, "[Managing IP Multicast Traffic: A First Look at the Issues, Tools, and Challenges](#)," IP Multicast Initiative White Paper, San Jose, California, USA, February 1999.
1. K. Almeroth, K. Obraczka and D. De Lucia, "[Pseudo-IP: Providing a Thin Network Protocol for Semi-Intelligent Wireless Devices](#)," *DARPA/NIST Smart Spaces Workshop*, Gaithersburg, Maryland, USA, July 1998.

E. Released Software Systems

19. ***A Multi-radio Wireless Mesh Network Architecture*** -- <http://moment.cs.ucsb.edu/tic/>. Released December 1, 2006 (with K. Ramachandran, I. Sheriff, and E. Belding). The software as part of a multi-radio wireless mesh network that includes a Split Wireless Router that alleviates the interference that can occur between commodity radios within a single piece of hardware. The second is server software to perform channel assignment and communicate the assignments throughout the mesh network.
18. ***AODV-Spanning Tree (AODV-ST)*** -- <http://www.cs.ucsb.edu/~krishna/aodv-st/>. Released September 1, 2006 (with K. Ramachandran and E. Belding). AODV-ST is an extension of [IPR2026-0041A](#) AODV

protocol specifically designed for wireless mesh networks. The advantages of AODV-ST over AODV include support for high throughput routing metrics, automatic route maintenance for common-case traffic, and low route discovery latency.

17. ***The Multicast Detective*** -- http://www.nmsl.cs.ucsb.edu/mcast_detective/. Released September 1, 2005 (with A. Sen Mazumder). The multicast detective is a robust solution to determine the existence and nature of multicast service for a particular user. By performing a series of tests, a user can determine whether there is network support for multicast, and consequently, whether a multicast group join is likely to succeed.
16. ***AutoCap: Automatic and Accurate Captioning*** -- <http://www.nmsl.cs.ucsb.edu/autocap/>. Released August 1, 2005 (with A. Knight). AutoCap is a software system that takes as input an audio/video file and a text transcript. AutoCap creates captions by aligning the utterances in the audio/video file to the transcript. For those words that are not recognized, AutoCap estimates when the words were spoken along with an error bound that gives the content creator an idea of caption accuracy. The result is a collection of accurately time-stamped captions that can be displayed with the video.
15. ***PAIRwise Plagiarism Detection System*** -- <http://cits.ucsb.edu/pair/>. Released July 1, 2005 (with A. Knight). PAIRwise is a plagiarism detection system with: (1) an easy-to-use interface for submitting papers, (2) a flexible comparison engine that allows intra-class, inter-class, and Internet-based comparisons, and (3) an intuitive graphical presentation of results.
14. ***DAMON Multi-Hop Wireless Network Monitoring*** -- <http://moment.cs.ucsb.edu/damon/>. Released October 1, 2004 (with K. Ramachandran and E. Belding). DAMON is a distributed system for monitoring multi-hop mobile networks. DAMON uses agents within the network to monitor network behavior and send collected measurements to data repositories. DAMON's generic architecture supports the monitoring of a wide range of protocol, device, or network parameters.
13. ***Multicast Firewall*** -- <http://www.nmsl.cs.ucsb.edu/mafia/>. Released June 1, 2004 (with K. Ramachandran). MAFIA, a multicast firewall and traffic management solution, has the specific aim of strengthening multicast security through multicast access control, multicast traffic filtering, and DoS attack prevention.
12. ***AODV@IETF Peer Routing Software*** -- <http://moment.cs.ucsb.edu/aodv-ietf/>. Released November 1, 2003 (with K. Ramachandran and E. Belding). One of the first large-scale efforts to run the Ad hoc On demand Distance Vector (AODV) routing protocol in a public space (at the Internet Engineering Task Force (IETF)). The implementation includes a daemon that runs on both the Linux and Windows operating systems.
11. ***Mobility Obstacles*** -- <http://moment.cs.ucsb.edu/mobility/>. Released September 1, 2003 (with A. Jardosh, E. Belding, and S. Suri). The topology and movement of nodes in ad hoc protocol simulation are key factors in protocol performance. In this project, we have developed ns-2 simulation plug-ins that create more realistic movement models through the incorporation of obstacles. These obstacles are utilized to restrict both node movement and wireless transmissions.
10. ***mwalk*** -- <http://www.nmsl.cs.ucsb.edu/mwalk/>. Released December 1, 2000 (with R. Chalmers). Mwalk is a collection of Java applications and Perl scripts which re-create a global view of a multicast session from mtrace and RTCP logs. Users to the site can download mwalk, examine the results of our analysis, or download data sets for use in simulations dependent on multicast tree characteristics.
9. ***MANTRA2*** -- <http://www.nmsl.cs.ucsb.edu/mantra/>. Released December 1, 1999 (with P. Rajvaidya). This new version of MANTRA focuses on the visualization of inter-domain routing statistics.

in conjunction with the Cooperative Association for Internet Data Analysis (CAIDA) we have developed advanced collection and visualization techniques.

8. **MRM** -- <http://www.nmsl.cs.ucsb.edu/mrm/>. Released October 1, 1999 (with K. Sarac). MRM is the Multicast Reachability Protocol. We have implemented an end-host agent that responds to MRM Manager commands. Our end-host agent works in conjunction with Cisco routers to detect and isolate multicast faults.
7. **MANTRA** -- <http://www.nmsl.cs.ucsb.edu/mantra/>. Released January 1, 1999 (with P. Rajvaidya). MANTRA is the Monitoring and Analysis of Traffic in Multicast Routers. It uses scripts to collect and display data from backbone multicast routers.
6. **SDR Monitor** -- <http://www.nmsl.cs.ucsb.edu/sdr-monitor/>. Released January 1, 1999 (with K. Sarac). The SDR Monitor receives e-mail updates from participants containing information about observed sessions in the MBone. A global view of multicast reachability is then constructed.
5. **The MHealth tool** -- <http://www.nmsl.cs.ucsb.edu/mhealth/>. Released September 1, 1998 (with D. Makofske). The mhealth tool graphically visualizes MBone multicast group trees and provides 'health' information including end-to-end losses per receiver and losses on a per hop basis. The implementation required expertise in Java, the MBone tools, and Unix.
4. **The MControl tool** -- <http://www.nmsl.cs.ucsb.edu/mcontrol/>. Released August 1, 1998 (with D. Makofske). Mcontrol is a tool to provide VCR-based interactivity for live MBone sessions. The implementation required expertise in Java, the MBone tools, and Unix.
3. **Interactive Multimedia Jukebox (IMJ)** -- <http://imj.ucsb.edu/>. Released October 1, 1996. The IMJ combines the WWW and the MBone conferencing tools to provide a multi-channel video jukebox offering both instructional and entertainment programming on a wide scale. The implementation required expertise in HTML, Perl, C, the MBone tools, and Unix.
2. **Mlisten** -- <http://www.cc.gatech.edu/computing/Telecomm/mbone/>. Released September 1, 1995. A tool to continuously collect MBone multicast group membership information including number and location of members, membership duration, and inter-arrival time for all audio and video sessions. The implementation required expertise in C, Tcl/Tk, the MBone tools, and UNIX socket programming.
1. **Audio-on-Demand (AoD)**. March 1, 1995. A server/client prototype to demonstrate interactivity in near VoD systems. The AoD server provides songs-on-demand and VCR-like functions via multicast IP over Ethernet. The implementation required expertise in C, OpenWindows programming, UNIX socket programming, and network programming.

F. Tutorials, Panels and Invited Talks

- "25th Anniversary Panel," Network and Operating System Support for Digital Audio and Video (NOSSDAV), Portland, Oregon, USA, March 2015.
- "Sensing and Opportunistic Delivery of Ubiquitous Video in Health Monitoring, On-Campus and Social Network Applications," Workshop on Mobile Video Delivery (MoViD), Chapel Hill North Carolina, USA, February 2012.
- "Medium Access in New Contexts: Reinventing the Wheel?," USC Invited Workshop on Theory and

Practice in Wireless Networks, Los Angeles, California, USA, May 2008.

- "The Wild, Wild West: Wireless Networks Need a New Sheriff," University of Florida CISE Department Lecture Series, Gainesville, Florida, USA, February 2008.
- "Distinguishing Between Connectivity, Intermittent Connectivity, and Intermittent Disconnectivity," Keynote at the ACM MobiCom Workshop on Challenged Networks (CHANTS), Montreal, CANADA, September 2007.
- "The Three Ghosts of Multicast: Past, Present, and Future," Keynote at the Trans-European Research and Education Networking Association (TERENA) Networking Conference, Lynby, DENMARK, May 2007.
- "Multicast Help Wanted: From Where and How Much?," Keynote at the Workshop on Peer-to-Peer Multicasting (P2PM), Las Vegas, Nevada, USA, January 2007.
- "The Confluence of Wi-Fi and Apps: What to Expect Next," Engineering Insights, UC-Santa Barbara, Santa Barbara, California, USA, October 2006.
- "Challenges, Opportunities, and Implications for the Future Internet," University of Minnesota Digital Technology Center, Minneapolis, Minnesota, USA, September 2006.
- "Wireless Technology as a Catalyst: Possibilities for Next-Generation Interaction," Santa Barbara Forum on Digital Transitions, Santa Barbara, California, USA, April 2006.
- "Challenges and Opportunities in an Internet with Pervasive Wireless Access," University of Texas--Dallas Computer Science Colloquium, Dallas, Texas, USA, March 2006.
- "Challenges and Opportunities with Pervasive Wireless in the Internet," Duke University Computer Science Colloquium, Durham, North Carolina, USA, February 2006.
- "The Span From Wireless Protocols to Social Applications," Intel Research Labs, Cambridge, United Kingdom, December 2005.
- "The Internet Dot.Com Bomb and Beyond the Dot.Com Calm," CSE IGERT and Cal Poly Lecture Series, San Luis Obispo, California, USA, October 2005.
- "Panel: Directions in Networking Research," IEEE Computer Communications Workshop (CCW), Irvine, California, USA, October 2005.
- "Economic Incentives for Ad Hoc Networks," KAIST New Applications Seminar, Seoul, South Korea, March 2004.
- "New Applications for the Next Generation Internet," Citrix Systems, Santa Barbara, California, USA, March 2004.
- "PI: The Imperfect Pursuit of Pure Pattern," CITS Visions in Technology Series, Santa Barbara, California, USA, January 2004.
- "Panel: Core Networking Issues and Protocols for the Internet," National Science Foundation (NSF) Division of Advanced Networking Infrastructure and Research (ANIR) Principal Investigators Workshop, Washington DC, USA, March 2003.

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- "Panel: Pricing for Content in the Internet," SPIE ITCOM Internet Performance and Control of Network Systems, Boston, Massachusetts, USA, July 2002.
- "The Technology Behind Wireless LANs," Central Coast MIT Enterprise Forum, Santa Barbara, California, USA, March 2002.
- "Lessons Learned in the Digital Classroom," Center for Information and Technology Brown Bag Symposium, Santa Barbara, California, USA, March 2002.
- "The Evolution of Advanced Networking Services: From the ARPANet to Internet2," California State University--San Luis Obispo CS Centennial Colloquium Series, San Luis Obispo, California, USA, February 2002.
- "Deployment of IP Multicast in Campus Infrastructures," Internet2 Campus Deployment Workshop, Atlanta, Georgia, USA, May 2001.
- "Multicast: Is There Anything Else to Do?," Sprint Research Retreat, Miami, Florida, USA, May 2001.
- "The Evolution of Next-Generation Internet Services and Applications," Government Technology Conference 2001 (GTC) for the Western Region, Sacramento, California, USA, May 2001.
- "I2 Multicast: Not WIDE-scale Deployment, FULL-scale Deployment," Closing Plenary, Internet2 Member Meetings, Washington, D.C., USA, March 2001.
- "Panel: Beyond IP Multicast," Content Delivery Networks (CDN), New York, New York, USA, February 2001.
- "Viable Multicast Pricing & Business Models for Wider-Scale Deployment," Content Delivery Networks (CDN), New York, New York, USA, February 2001.
- "IP Multicast: Modern Protocols, Deployment, and Management," Content Delivery Networks (CDN), New York, New York, USA, February 2001 & San Jose, California, USA, December 2001.
- "Under the Hood of the Internet," Technology 101: Technology for Investors, Center for Entrepreneurship & Engineering Management, November 2000.
- "Understanding Multicast Traffic in the Internet," (1) University of Virginia, (2) University of Maryland, and (3) Columbia University, September 2000.
- "The Bad, The Ugly, and The Good: The Past, Present, and Future of Multicast," Digital Fountain, San Francisco, California, USA, August 2000.
- "Implications of Source-Specific Multicast (SSM) on the Future of Internet Content Delivery," Occam Networks, Santa Barbara, California, USA, August 2000.
- "Introduction to Multicast Routing Protocols," UC-Berkeley Open Mash Multicast Workshop, Berkeley, California, USA, July 2000.
- "Efforts to Understand Traffic and Tree Characteristics," University of Massachusetts--Amherst Colloquia, Amherst, Massachusetts, USA, May 2000.
- "Monitoring Multicast Traffic," Sprint Research Retreat, Half Moon Bay, California, USA, April 2000.

- "What is the Next Generation of Multicast in the Internet?," HRL Laboratories, Malibu, California, USA, January 2000.
- "Mission and Status of the Center for Information Technology and Society (CITS)," Intel Research Council, Portland, Oregon, USA, September 1999.
- "Multicast at a Crossroads," IP Multicast Initiative Summits and Bandwidth Management Workshops, San Francisco, CA, USA, (1) October 1999; (2) February 2000; and (3) June 2000.
- "IP Multicast: Modern Protocols, Deployment, and Management," Network+Interop: (1) Las Vegas, Nevada, USA--May 2000; (2) Tokyo, JAPAN--June 2000; (3) Atlanta, Georgia, USA--September 2000; (4) Las Vegas, Nevada, USA--May 2001; (5) Las Vegas, Nevada, USA--May 2002.
- "IP Multicast: Practice and Theory" (w/ Steve Deering), Network+Interop: (1) Las Vegas, Nevada, USA--May 1999; (2) Tokyo, JAPAN--June 1999; and (3) Atlanta, Georgia, USA--September 1999.
- "Internet2 Multicast Testbeds and Applications," Workshop on Protocols for High Speed Networks (PfHSN), Salem, Massachusetts, USA, August 1999.
- "IP Multicast: Protocols for the Intra- and Inter-Domain," Lucent Technologies, Westford, Massachusetts, USA, August 1999.
- "Internet2 Multicast Testbeds and Applications," NASA Workshop: Bridging the Gap, Moffett Field, California, USA, August 1999.
- "The Evolution of Next-Generation Services and Applications in the Internet," Tektronix Distinguished Lecture Series, Portland, Oregon, USA, May 1999.
- "Multicast Applications and Infrastructure in the Next Generation Internet," CENIC 99 Workshop on Achieving Critical Mass for Advanced Applications, Monterey, California, USA, May 1999.
- "Multicast Traffic Monitoring and Analysis Work at UCSB" (w/ P. Rajvaidya), Workshop on Internet Statistics and Metrics Analysis (ISMA), San Diego, California, USA, April 1999.
- "How the Internet Works: Following Bits Around the World," Science Lite, Santa Barbara General Affiliates and Office of Community Relations, California, USA, February 1999.
- "Managing Multicast: Challenges, Tools, and the Future," IP Multicast Initiative Summit, San Jose, California, USA, February 1999.
- "The Future of Multicast Communication and Protocols," Internet Bandwidth Management Summit (iBAND), San Jose, California, USA, November 1998.
- "An Overview of IP Multicast: Applications and Deployment," (1) Workshop on Evaluating IP Multicast as the Solution for Webcasting Real-Time Networked Multimedia Applications, New York, New York, USA, July 1998; and (2) Satellites and the Internet Conference, Washington, D.C., USA, July 1998.
- "IETF Developments in IP Multicast," IP Multicast Initiative Summit, San Jose, California, USA, February 1998.
- "An Introduction to IP Multicast and the Multicast Backbone (MBone)" vBNS IP2026-00411g

sponsored by the National Center for Network Engineering (NLANR), San Diego, California, USA, February 1998.

- "Using Multicast Communication to Deliver WWW Pages" Computer Communications Workshop (CCW '97), Phoenix, Arizona, USA, September 1997.

G. Research Funding

- K. Almeroth, "Packet Scheduling Using IP Embedded Transport Instrumentation," Cisco Systems Inc., \$100,000, 3/1/13-8/31/14.
- K. Almeroth, E. Belding and S.J. Lee, "GOALI: Maximizing Available Bandwidth in Next Generation WLANs", National Science Foundation (NSF), \$101,088, 10/1/13-9/30/14.
- K. Almeroth and E. Belding, "GOALI: Intelligent Channel Management in 802.11n Networks," National Science Foundation (NSF), \$51,000, 10/1/10-9/30/11.
- B. Zhao, K. Almeroth, H. Zheng, and E. Belding, "NeTS: Medium: Airlab: Distributed Infrastructure for Wireless Measurements," National Science Foundation (NSF), \$700,000, 9/1/09-8/13/13.
- K. Almeroth, E. Belding and T. Hollerer, "NeTS-WN: Wireless Network Health: Real-Time Diagnosis, Adaptation, and Management," National Science Foundation (NSF), \$600,000, 10/1/07-9/30/10.
- K. Almeroth, "Next-Generation Service Engineering in Internet2," University Consortium for Advanced Internet Development (UCAID), \$1,254,000, 7/1/04-6/30/09 (reviewed and renewed each year).
- B. Manjunath, K. Almeroth, F. Bullo, J. Hespanha, T. Hollerer, C. Krintz, U. Madhow, K. Rose, A. Singh, and M. Turk, "Large-Scale Multimodal Wireless Sensor Network," Office of Naval Research Defense University Research Instrumentation Program (DURIP), \$655,174, 4/14/08-4/14/09.
- K. Almeroth and E. Belding, "Improving Robustness in Evolving Wireless Infrastructures," Intel Corporation, \$135,000, 7/1/06-6/30/09 (reviewed and renewed for second and third year).
- K. Almeroth and K. Sarac, "Bridging Support in Mixed Deployment Multicast Environments," Cisco Systems Inc., \$100,000, 9/1/07-8/31/08.
- K. Sarac and K. Almeroth, "Building the Final Piece in One-to-Many Content Distribution," Cisco Systems Inc., \$95,000, 9/1/06-8/31/07.
- E. Belding, K. Almeroth and J. Gibson, "Real-Time Communication Support in a Ubiquitous Next-Generation Internet," National Science Foundation (NSF), \$900,000, 10/1/04-9/30/07.
- K. Almeroth and K. Sarac, "Improving the Robustness of Multicast in the Internet," Cisco Systems Inc., \$80,000, 9/1/04-8/31/05.
- R. Mayer, B. Bimber, K. Almeroth and D. Chun, "Assessing the Pedagogical Implications of Technology in College Courses," Mellon Foundation, \$350,000, 7/1/04-6/30/07.
- B. Bimber, A. Flanagan and C. Stol, "Technological Change and Collective Association: Changing

Relationships Among Technology, Organizations, Society and the Citizenry," National Science Foundation (NSF), \$329,175, 7/1/04-6/30/07.

- K. Almeroth and B. Bimber, "Plagiarism Detection Techniques and Software," UCSB Instructional Development, \$22,000, 7/1/04-6/30/05.
- K. Almeroth, "Student Travel Support for the 14th International Workshop on Network and Operating Systems Support for Digital Audio and Video (NOSSDAV)," National Science Foundation (NSF), \$10,000, 5/1/04-8/31/04.
- K. Almeroth, "An Automated Indexing System for Remote, Archived Presentations," QAD Inc., \$25,000, 5/1/04-6/30/05.
- K. Almeroth and M. Turk, "A Remote Teaching Assistant Support System," Microsoft, \$40,000, 1/1/04-6/30/05.
- K. Almeroth, "Supporting Multicast Service Functionality in Helix," Real Networks, \$30,000, 9/1/03-6/30/04.
- K. Almeroth and E. Belding, "Service Discovery in Mobile Networks," Nokia Summer Research Grant (U. Mohan), \$10,240, 7/1/03-9/30/03.
- K. Almeroth, D. Zappala, "Building a Global Multicast Service," Cisco Systems Inc., \$100,000, 1/1/03-6/30/04.
- K. Almeroth, "Developing A Dynamic Protocol for Candidate Access Router Discovery," Nokia Graduate Student Fellowship (R. Chalmers), \$26,110, 9/01/02-6/30/03.
- B. Bimber and K. Almeroth, "The Role of Collaborative Groupware in Organizations," Toole Family Foundation, \$182,500 (\$20,000 cash plus \$162,500 in software), 9/1/02-8/30/07.
- B. Manjunath, et al., "Digital Multimedia: Graduate Training Program in Interactive Digital Multimedia," National Science Foundation (NSF), \$2,629,373, 4/1/02-3/31/07.
- J. Green, K. Almeroth, et al., "Inquiry in the Online Context: Learning from the Past, Informing the Future," UCSB Research Across Disciplines, \$10,000, 9/1/01-8/31/02.
- K. Almeroth, "Monitoring and Maintaining the Global Multicast Infrastructure," Cisco Systems Inc., \$54,600, 7/1/01-6/30/02.
- R. Kemmerer, K. Almeroth, et al., "Hi-DRA High-speed, Wide-area Network Detection, Response, and Analysis," Department of Defense (DoD), \$4,283,500, 5/1/01-4/30/06.
- A. Singh, K. Almeroth, et al., "Digital Campus: Scalable Information Services on a Campus-wide Wireless Network," National Science Foundation (NSF), 1,450,000, 9/15/00-12/31/04.
- K. Almeroth, "Visualizing the Global Multicast Infrastructure," UC MICRO w/ Cisco Systems Inc., \$85,438, 7/1/00-6/30/02.
- H. Lee, K. Almeroth, et al., "Dynamic Sensing Systems," International Telemetering Foundation, \$260,000, 07/01/00-06/30/04.
- B. Bimber and K. Almeroth, "Funding for the Center on Information Technology and Society,"

\$250,000 from Dialogic (an Intel Company) and \$250,000 from Canadian Pacific.

- K. Almeroth, "CAREER: From Protocol Support to Applications: Elevating Multicast to a Ubiquitous Network Service," National Science Foundation (NSF), \$200,000, 9/1/00-8/31/04.
- K. Almeroth, "Characterizing Multicast Use and Efficiency in the Inter-Domain," Sprint Advanced Technology Laboratories, \$62,500, 3/1/00-6/30/01.
- K. Almeroth, "Producing the Next Generation of Multicast Monitoring and Management Protocols and Tools," UC MICRO w/ Cisco Systems Inc., \$124,500, 7/1/99 - 6/30/01.
- K. Almeroth, "Utilizing Satellite Links in the Provision of an Inter-Wide Multicast Service," HRL Laboratories, \$20,000, 7/1/99 - 6/30/00.
- T. Smith, K. Almeroth, et al., "Alexandria Digital Earth Prototype," National Science Foundation, \$5,400,000, 4/1/99-3/31/04.
- V. Vesna, K. Almeroth, et al., "Online Public Spaces: Multidisciplinary Explorations in Multi-User Environments (OPS:MEME), Phase II," UCSB Research Across Disciplines, \$50,000, 9/1/98-8/31/99.
- K. Almeroth, "Techniques and Analysis for the Provision of Multicast Route Management," UC MICRO w/ Cisco Systems Inc., \$97,610, 7/1/98 - 6/30/00.
- K. Almeroth, "Capturing and Modeling Multicast Group Membership in the Multicast Backbone (MBone)," UC MICRO w/ Hughes Research Labs, \$19,146, 7/1/98 - 12/31/99.
- K. Almeroth, "Building a Content Server for the Next Generation Digital Classroom," UCSB Faculty Research Grant, \$5,000, 7/1/98-6/31/99.

H. Research Honors and Awards

- IEEE Fellow Status, 2014
- Finalist for Best Paper Award, IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON), June 2008
- Best Paper Award, Passive and Active Measurement (PAM) Conference, April 2007
- Outstanding Paper Award, World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA), June 2006
- IEEE Senior Member Status, 2003
- Finalist for Best Student Paper Award, ACM Multimedia, December 2002
- Outstanding Paper Award, World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA), June 2002
- Computing Research Association (CRA) Digital Government Fellowship, 2001
- National Science Foundation CAREER Award, 2000
- Best Paper Award, 7th International World Wide Web Conference, April 1998

III. Service

A. Professional Activities

1. Society Memberships

Member, Association for Computing Machinery (ACM): 1993-present
Member, ACM Special Interest Group on Communications (SIGComm): 1993-present
Fellow, Institute of Electrical and Electronics Engineers (IEEE): 1993-present
Member, IEEE Communications Society (IEEE ComSoc): 1993-present
Member, American Society for Engineering Education (ASEE): 2003-2006

2. Review Work for Technical Journals and Publishers

NSF CISE research proposals, IEEE/ACM Transactions on Networking, IEEE/ACM Transactions on Computers, IEEE/ACM Transactions on Communications, IEEE Transactions on Circuits and Systems for Video Technology, IEEE Transactions on Parallel and Distributed Systems, IEEE Transactions on Multimedia, IEEE Communications, IEEE Communications Letters, IEEE Network, IEEE Internet Computing, IEEE Multimedia, IEEE Aerospace & Electronics Systems Magazine, ACM Transactions on Internet Technology, ACM Transactions on Multimedia Computing, Communications and Applications, ACM Computing Surveys, ACM Computer Communications Review, ACM Computeres in Entertainment, ACM/Springer Multimedia Systems Journal, AACE Journal of Interactive Learning (JILR), International Journal of Computer Mathematics, Journal of Communications and Networks, Journal of Parallel and Distributed Computing, Journal of Network and Systems Management, Journal of High Speed Networking, Journal of Communications and Networks, Journal on Selected Areas in Communications, Journal of Wireless Personal Communications, Personal Mobile Communications, Annals of Telecommunications, International Journal of Wireless and Mobile Computing, Pervasive and Mobile Computing (PMC), Wireless Networks Journal, Computer Networks Journal, Cluster Computing, Computer Communications, Mobile Computing and Communications Review, Performance Evaluation, Software--Practice & Experience, Information Processing Letters, ACM Sigcomm, ACM Multimedia, ACM Network and System Support for Digital Audio and Video Workshop (NOSSDAV), ACM Sigcomm Workshop on the Economics of Peer-to-Peer Systems (P2PEcon), ACM Sigcomm Workshop on Challenged Networks (CHANTS), IEEE Infocom, IEEE Globecom, IEEE Global Internet (GI) Symposium, IEEE Globecom Automatic Internet Symposium, IEEE Globecom Internet Services and Enabling Technologies (IS&ET) Symposium, IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM), IEEE International Conference on Network Protocols (ICNP), IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON), IEEE International Conference on Multimedia and Exposition (ICME), IEEE International Conference on Communications (ICC), IEEE International Conference on Parallel and Distributed Systems (ICPADS) IEEE International Symposium on High-Performance Distributed Computing (HPDC), IEEE International Conference on Distributed Computing Systems (ICDCS), IEEE International Workshop on Quality of Service (IWQoS), IEEE/IFIP Network Operations and Management Symposium (NOMS), IFIP/IEEE International Symposium on Integrated Network Management (IM), IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS), IEEE Aerospace & Electronics Systems Magazine, SPIE Conference on Multimedia Computing and Networking (MMCN), IFIP

Networking, IASTED International Conference on Information Systems and Databases (ISD), IASTED International Conference on Communications, Internet, and Information Technology, IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA), IASTED International Conference on European Internet and Multimedia Systems and Applications (EuroIMSA), IASTED International Conference on Communications and Computer Networks (CCN), IASTED International Conference on Software Engineering and Applications (SEA), International Conference on Computer and Information Science (ICIS), International Association for Development of the Information Society (IADIS) International Conference on the WWW/Internet, Workshop on Network Group Communication (NGC), International Conference on Next Generation Communication (CoNEXT), International Conference on Parallel Processing (ICPP), International Conference on Computer Communications and Networks (IC3N), International Workshop on Hot Topics in Peer-to-Peer Systems (Hot-P2P), International Workshop on Wireless Network Measurements (WiNMee), International Workshop on Incentive-Based Computing (IBC), International Workshop on Multi-hop Ad Hoc Networks (REALMAN), International Workshop on Broadband Wireless Multimedia: Algorithms, Architectures and Applications (BroadWIM), International Packet Video (PV) Workshop, High Performance Networking Conference (HPN), International Parallel Processing Symposium (IPPS), International Symposium on Innovation in Information & Communication Technology (ISIICT), Workshop on Coordinated Quality of Service in Distributed Systems (COQODS), Pearson Education (Cisco Press) Publishers, Macmillan Technical Publishing, and Prentice Hall Publishers.

3. Conference Committee Activities

Journal/Magazine Editorial Board

IEEE Transactions on Mobile Computing (TMC): 2006-2011, 2017-2020 (Associate Editor-in-Chief)
 IEEE Networking Letters: 2018-2021
 IEEE Transactions on Network and Service Management (TNSM): 2015-2021
 Journal of Network and Systems Management (JNSM): 2011-present
 IEEE/ACM Transactions on Networking (ToN): 2003-2009, 2013-2017
 ACM Computers in Entertainment: 2002-2015
 IEEE Network: 1999-2012
 AACE Journal of Interactive Learning Research (JILR): 2003-2012
 IEEE Transactions on Mobile Computing (TMC): 2006-2011
 ACM Computer Communications Review (CCR): 2006-2010

Journal/Magazine Guest Editorship

IEEE Journal on Selected Areas in Communications (JSAC) Special Issue on "Delay and Disruption Tolerant Wireless Communication", June 2008
 Computer Communications Special Issue on "Monitoring and Measuring IP Networks", Summer 2005
 Computer Communications Special Issue on "Integrating Multicast into the Internet", March 2001

Conference/Workshop Steering Committee

IEEE International Conference on Network Protocols (ICNP): 2007-present
 ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006-present

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IEEE Global Internet (GI) Symposium: 2005-2013, 2018-present
International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV): 2001-2020, 2005-2011 (chair), 2012-2020 (co-chair)
IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2005-2009

Conference/Workshop Chair

International Conference on Communication Systems and Networks (COMSNETS): 2014 (co-chair)
ACM International Conference on Next Generation Communication (CoNext): 2013 (co-chair)
ACM RecSys News Recommender Systems (NRS) Workshop and Challenge: 2013 (co-chair)
ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006 (co-chair)
IEEE International Conference on Network Protocols (ICNP): 2003 (co-chair), 2006
International Workshop on Wireless Network Measurements (WiNMee): 2006 (co-chair)
IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2002 (co-chair)
International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV): 2002 (co-chair), 2003 (co-chair)
IEEE Global Internet (GI) Symposium: 2001 (co-chair), 2018 (co-chair)
International Workshop on Networked Group Communication (NGC): 2000 (co-chair)

Program Chair

International Conference on Computer Communication and Networks (ICCCN): 2015 (Track co-chair)
International Conference on Communication Systems and Networks (COMSNETS): 2010
IEEE International Conference on Network Protocols (ICNP): 2008 (co-chair)
IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON): 2007 (co-chair)
IFIP Networking: 2005 (co-chair)

Posters/Demonstrations Chair

ACM Sigcomm: 2012 (co-chair)

Student Travel Grants Chair

ACM Sigcomm: 2010 (co-chair)

Publicity Chair

IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2004 (co-chair)

Keynote Chair

IEEE Infocom: 2005 (co-chair)

Local Arrangements Chair

Internet2 "Field of Dreams" Workshop: 2000

Tutorial Chair

ACM Multimedia: 2000

IEEE International Conference on Network Protocols (ICNP): 1999

Panel/Session Organizer

NSF ANIR PI 2003 Panel on "Core Networking Issues and Protocols for the Internet"

CCW 2001 Session on "Multicast/Peer-to-Peer Networking"

NOSSDAV 2001 Panel on "Multimedia After a Decade of Research"

NGC 2000 Panel on "Multicast Pricing"

Technical Program Committee

IEEE International Conference on Network Protocols (ICNP): 1999, 2000, 2001, 2003, 2004, 2005, 2006, 2007, 2008, 2009 (Area Chair), 2010 (Area Chair), 2011 (Area Chair), 2012 (Area Chair), 2013, 2014 (Area Chair), 2015 (Area Chair), 2016 (Area Chair), 2017 (Area Chair), 2018 (Area Chair), 2019 (Area Chair), 2020 (Area Chair), 2021 (Area Chair)

International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV): 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019

ACM Multimedia (MM): 2001, 2003, 2004, 2005 (short paper), 2006, 2007, 2008, 2008 (short paper), 2010, 2011, 2012, 2013, 2015, 2016, 2017, 2018, 2019, 2023, 2024, 2026

IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON): 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011 (Area Chair), 2012 (Area Chair), 2013, 2014 (Area Chair), 2015, 2016 (Area Chair), 2017, 2018, 2019

IEEE/IFIP Network Operations and Management Symposium (NOMS): 2004, 2006, 2010
IEEE Infocom: 2004, 2005, 2006, 2008, 2009, 2010 (Area Chair), 2011 (Area Chair), 2012 (Area Chair)

IFIP Networking: 2004, 2005, 2006, 2007, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2022

IEEE International Conference on Communications (ICC) Next Generation Networking and Internet Symposium (NGNI): 2018, 2019

ACM Workshop on Mobile Video (MoVid): 2014, 2015, 2016, 2017

ACM Student Research Competition (SRC) Grand Finals: 2014

Mobile and Social Computing for Collaborative Interactions (MSC): 2014

IEEE Conference on Communications and Network Security (CNS): 2013

IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM): 2005, 2006, 2007, 2008, 2009, 2010

ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006, 2008, 2009, 2010, 2011, 2012, 2016, 2017, 2018, 2019

IEEE International Conference on Distributed Computing Systems (ICDCS): 2006, 2010, 2011, 2012, 2013

International Workshop on Wireless Network Measurements (WiNMee): 2006, 2008, 2010

ACM Sigcomm: 2004 (poster), 2008 (poster), 2010

IEEE International Conference on Computer Communication and Networks (IC3N): 2008, 2009, 2010, 2011, 2012

International Conference on Communication Systems and Networks (COMSNETS): 2009, 2010, 2011, 2012, 2013

International Conference on Sensor Networks (SENSORNETS): 2012

International Workshop on Social and Mobile Computing for Collaborative Environments (SOMOCO): 2012

Workshop on Scenarios for Network Evaluation Studies (SCENES): 2009, 2010, 2011

ACM Multimedia Systems (MMSys): 2010, 2011, 2012, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022

IEEE International Symposium on Multimedia (ISM): 2016

IEEE International Conference on Pervasive Computing and Communications (PerCom): 2010

IEEE Wireless Communications and Networking Conference (WCNC): 2010, 2011

ACM International Symposium on Mobility Management and Wireless Access (MobiWac): 2010, 2011

International Conference on Computing, Networking and Communications, Internet Services and Applications Symposium (ICNC-ISA): 2012, 2013

IEEE WoWMoM Workshop on Hot Topics in Mesh Networking (HotMesh): 2010, 2011, 2012, 2013

IEEE Workshop on Pervasive Group Communication (PerGroup): 2010

ACM International Conference on Next Generation Communication (CoNEXT): 2005, 2006, 2007, 2009, 2012

IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets) Wireless Communications, Networks and Systems Symposium: 2007, 2008, 2009

IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets) Internet Technologies Symposium: 2007, 2008, 2009

International Workshop on Mobile and Networking Technologies for Social Applications (MONET): 2008, 2009

Extreme Workshop on Communication-The Midnight Sun Expedition (ExtremeCom): 2009

IEEE International Workshop on Cooperation in Pervasive Environments (CoPE): 2009

International Workshop on the Network of the Future (FutureNet): 2009, 2010, 2011, 2012

IEEE International Conference on Multimedia and Exposition (ICME): 2010

SPIE Conference on Multimedia Computing and Networking (MMCN): 2004, 2008

ACM Sigcomm Workshop on the Economics of Networks, Systems, and Computation (NetEcon): 2008

IEEE International Conference on Communications (ICC): 2008

IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS): 2008

IFIP/IEEE International Symposium on Integrated Network Management (IM): 2005, 2007

Global Internet (GI) Symposium: 2001, 2002, 2004, 2006, 2007, 2022, 2023

IEEE/ACM International Conference on High Performance Computing (HiPC): 2007

ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc): 2007

IEEE Workshop on Embedded Systems for Real-Time Multimedia (ESTIMedia): 2007

IEEE/IFIP Wireless On Demand Network Systems and Services (WONS): 2007

IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2001, 2002, 2003, 2004, 2005, 2006

IASTED International Conference on European Internet and Multimedia Systems and Applications (EuroIMSA): 2004, 2006

IEEE International Conference on Parallel and Distributed Systems (ICPADS): 2005, 2006

IEEE Globecom Internet Services and Enabling Technologies (IS&ET) Symposium: 2006

International Workshop on Incentive-Based Computing (IBC): 2006

IEEE International Workshop on Quality of Service (IWQoS): 2006, 2014, 2015

International Workshop on Multi-hop Ad Hoc Networks (REALMAN): 2006
 IEEE Globecom Automatic Internet Symposium: 2005
 ACM Sigcomm Workshop on the Economics of Peer-to-Peer Systems (P2PEcon): 2005
 International Conference on Parallel Processing (ICPP): 2001, 2003, 2004
 International Packet Video (PV) Workshop: 2002, 2003, 2004
 IEEE International Symposium on High-Performance Distributed Computing (HPDC): 2004
 International Workshop on Broadband Wireless Multimedia: Algorithms, Architectures and Applications (BroadWIM): 2004
 International Symposium on Innovation in Information & Communication Technology (ISIICT): 2004
 Workshop on Coordinated Quality of Service in Distributed Systems (COQODS): 2004
 IASTED International Conference on Networks and Communication Systems (NCS): 2004
 IASTED International Conference on Communications, Internet, and Information Technology (CIIT): 2004
 IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA): 2003, 2004
 International Workshop on Networked Group Communication (NGC): 1999, 2000, 2001, 2002, 2003
 International Association for Development of the Information Society (IADIS)
 International Conference on the WWW/Internet: 2003
 International Conference on Computer and Information Science (ICIS): 2003
 Human.Society@Internet: 2003
 IASTED International Conference on Communications and Computer Networks (CCN): 2002
 The Content Delivery Networks (CDN) Event: 2001
 IP Multicast Initiative Summit: 1998, 1999, 2000
 Corporation for Education Network Initiatives in California (CENIC): 1999
 Internet Bandwidth Management Summit (iBAND): 1998, 1999

B. Technical Activities

1. Working Groups

Internet2 Working Group on Multicast, Chair: 1998-2005
 IEEE Communications Society Internet Technical Committee (ITC), Conference Coordinator: 2000-2004
 IETF Multicast Directorate (MADDOGS), Member: 1999-2001
 IASTED Technical Committee on the Web, Internet and Multimedia, Member: 2002-2005
 Internet Engineering Task Force (IETF), various working groups: 1995-present

2. Meeting Support Work

Internet Engineering Task Force MBone broadcasts: 1995-2005
 Conference MBone broadcasts: Sigcomm '99, and '00
 Interop+Networld Network Operations Center (NOC) Team Member: 1998-2006-00411
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C. University of California Committees

1. Department of Computer Science Committees

Public Relations: 2005-2006 (chair 2005-2006), 2009-2011 (chair 2009-2011)
Strategic Planning: 2000-2002, 2003-2006, 2009-2011
Undergraduate Advising and Affairs: 2006-2007, 2014-2015
Vice Chair: 2000-2005
Graduate Admissions: 2000-2005 (chair 2000-2005), 2011-2012
Graduate Affairs: 2000-2005 (co-chair 2000-2005)
Teaching Administration: 2000-2005
Facilities: 1997-2001 (chair 1999-2000), 2006-2007
External Relations: 1999-2002
Computer Engineering Public Relations: 2011-2012
Computer Engineering Awards: 2011-2012
Computer Engineering Administration/Recruiting: 1998-2001
Computer Engineering Lab and Computer Support: 1998-2001
Faculty Recruiting: 1999-2002
Graduate Advising: 1998-1999, 2000-2005

2. University Committees

Member, Campus Budget and Planning: 2013-2015
Faculty, Cognitive Science Program: 2006-2020
Faculty, Technology Management Program (TMP): 2003-2014
Faculty, Media Arts and Technology (MAT) Program: 1998-2014
Faculty, Computer Engineering Degree Program: 1998-2020
Steering Committee, Center for Information Technology and Society (CITS): 2012-2020
Associate Director, Center for Information Technology and Society (CITS): 1999-2012
Member, Campus Committee on Committees: 2010-2013
Member, Campus Income and Recharge Committee: 2010-2013
Member, College of Engineering Executive Committee: 2010-2012 (chair 2011-2012), 2014-2015 (chair 2014-2015)
Member, Distinguished Teaching Award Committee: 2009, 2010, 2011
Member, Campus Classroom Design and Renovation Committee: 2003-2010
Member, ISBER Advisory Committee: 2008-2011
Member, Fulbright Campus Review Committee: 2007
Member, Faculty Outreach Grant Program Review Committee: 2007
Executive Vice Chancellor's Information Technology Fee Committee: 2005-2006
Council on Research and Instructional Resources: 2003-2006
Executive Vice Chancellor's Working Group on Graduate Diversity: 2004-2005
Member, Engineering Pavillion Planning Committee: 2003-2005
Information Technology Board: 2001-2004
Executive Committee, Center for Entrepreneurship & Engineering Management (CEEM): 2001-2004

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3. System Wide Committees

UCSB Representative to the Committee on Information Technology and Telecommunications Policy (ITTP): 2003-2005

UCSB Representative to the Executive Committee, Digital Media Innovation (DiMI): 1998-2003

D. Georgia Tech Committees and Service (while a graduate student)

Graduate Student Body President: 1994-1995

Georgia Tech Executive Board: 1994-1995

Georgia Tech Alumni Association Executive Committee: 1994-1995

Dean of Students National Search Committee: 1995

Institute Strategic Planning Committee: 1994-1996

Cases in last 4 years I have been deposed or testified at hearing/trial:

- A deposition in Inter Partes Review of U.S. Patent Nos. 9,860,198 (IPR2021-00882) and 10,728,192 (IPR2021-00883) [Meta Platforms, Inc. v. Wrinkl, Inc.]. 12/2021-06/2022.
- Depositions in TQ Delta, LLC v. AdTran, Inc. (14-cv-954-RGA, 15-cv-121-RGA, D. Del). 03/2017-06/2022.
- Depositions in Inter Partes Review of U.S. Patent Nos. 8,166,081 (IPR2021-01267), 8,688,028 (IPR2021-01303), 8,903,307 (IPR2021-01305), and 8,200,203 (IPR2021-01371) [Hyundai Motor America v. StratosAudio, Inc.]. 06/2021-08/2022.
- A deposition and trial testimony in Shopify, Inc. v. Express Mobile, Inc. (1:19-cv-00439-RGA, D. Del.). 05/2020-08/2022.
- A deposition in FirstFace Co, LTD v. Apple, Inc (3:18-cv-02245-JD, N. D. Cal.). 05/2022-11/2022.
- Depositions in Inter Partes Review of U.S. Patent Nos. 9,291,475 (IPR2022-00708 and IPR2023-00031); 9,602,608 (IPR2022-00709); 7,484,008 (IPR2022-00857); and 6,832,283 (IPR2022-0970) [Toyota Motor Corp. and American Honda Motor Co, Inc. v. Intellectual Ventures II LLC]. 01/2022-02/2023.
- A deposition in Inter Partes Review of U.S. Patent No. 9,182,231 (IPR2022-00586) [Qualcomm Inc. v. FedEx Corporate Services, Inc.]. 09/2021-04/2023.
- A deposition in WebRoot, Inc. and Open Text, Inc. v. Trend Micro, Inc. (22-cv-00239-ADA-DTG, W. D. Tex.). 06/2022-04/2023.
- Depositions and trial testimony in Sonos, Inc. v. Google, LLC (6:20-cv-881-ADA, W. D. Tex.; 3:20-cv-06754-WHA, N. D. Cal.; and 3:21-cv-07559-WHA, N. D. Cal.). 11/2019-05/2023.
- A deposition in Inter Partes Review of U.S. Patent No. 8,072,968 (IPR2022-00890) [IBM Corp. v. Ebates Performance Marketing, Inc.]. 06/2022-05/2023.
- Depositions and trial testimony in Personal Audio, LLC v. Google, Inc. (1:17-cv-01751-VAC-CJB, D. Del). 03/2018-06/2023.
- A deposition and trial testimony in Centripetal Networks, Inc. v. Cisco Systems, Inc. (2:18-cv-00094, E. D. Va.). 01/2019-06/2023.
- A deposition in Orckit Corp v. Cisco Systems, Inc. (2:22-cv-276, E. D. Tex.). 05/2023-06/2023.
- A deposition and trial testimony in Touchstream Technologies, Inc. v. Google, LLC (6:21-cv-00569-ADA, W. D. Tex.). 08/2022-07/2023.
- A deposition in Inter Partes Review of U.S. Patent No. 8,784,113 (IPR2022-01439) [Go1 Pty, Ltd. v. OpenSesame, Inc.]. 01/2022-09/2023.
- A deposition and trial testimony in SB IP Holdings, LLC v. Vivint Smart Home, Inc. (4:20-cv-00886-ALM, E. D. Tex.). 12/2021-10/2023.

- Depositions and trial testimony in Alacritech, Inc. v. Centurylink Communications LLC; Winstron Corporation, Dell, Inc. (2:16-cv-693-RWS, 2:16-cv-692-RWS, 2:16-cv-695-RWS, E. D. Tex.). 04/2016-10/2023.
- A deposition in Inter Partes Review of U.S. Patent Nos. 9,503,498 (IPR2023-00185); 9,516,091 (IPR2023-00186); and 8,924,457 (IPR2023-00187) [Bright Data LTD v. Oxyllabs, UAB]. 06/2020-11/2023.
- Trial testimony in GoodRx, Inc. v. Famulus Health LLC (AAA Ref. No. 01-23-000-5919). 06/2023-11/2023.
- A deposition in Entropic Communications LLC v. Charter Communications, Inc. (2:22-cv-00125-JRG, E. D. Tex.). 03/2023-12/2023.
- Depositions in Post-Grant Review of U.S. Patent No. 10,782,951 (PGR2021-00096) and 11,157,256 (PGR2022-00053) [IronSource Ltd. v. Digital Turbine, Inc.]. 05/2021-12/2023.
- Trial testimony in Certain Wi-Fi Routers, Wi-Fi Devices, Mesh Wi-Fi Network Devices, and Hardware and Software Components Thereof (US ITC Inv. No. 337-TA-1361) [Netgear v. TP-Link]. 05/2023-01/2024.
- A deposition in Antonio McKinney et al. v. Corsair Gaming, Inc. (3:22-cv-00312-CRB, N. D. Cal.). 07/2023-01/2024.
- A deposition in Certain Fitness Devices, Streaming Components Thereof, and Systems Containing Same (US ITC Inv. No. 337-TA-1265E) [iFit Inc., FreeMotion Fitness, Inc. and NordicTrack, Inc. v. DISH DBS Corporation, DISH Technologies LLC, and Sling TV LLC]. 10/2023-02/2024.
- A deposition in Marble VOIP Partners LLC v. Zoom Video Communications, Inc. 4:23-cv-03619-JSW, N. D. Cal.). 12/2023-04/2024.
- Depositions in IBM Corp. v. Rakuten, Inc. and Ebates Performance Marketing, Inc. (21-461-VAC, D. Del.). 06/2022-06/2024.
- A deposition and trial testimony in Omnitracs, LLC v. Platform Science, Inc. (3:20-cv-0958-CAB-DDL, S. D. Cal.). 05/2023-07/2024.
- A deposition in NetSocket, Inc. v. Cisco Systems, Inc. (2:22-cv-00172-JRG, E. D. Tex.). 09/2022-08/2024.
- Depositions in Partes Review of U.S. Patent Nos. 7,230,931 (IPR2023-00098) and 9,426,794 (IPR2023-01147) [Verizon Wireless v. General Access Solutions, Ltd.]. 03/2023-08/2024.
- A deposition and trial testimony in International Business Machines Corp v. Zynga, Inc. (22-590-GBW, D. Del.). 08/2023-09/2024.
- A deposition in Lionra Technologies Limited v. Fortinet, Inc. (2:22-cv-00322-JRG-RSP, E. D. Tex.). 02/2023-09/2024.
- Depositions in STA Group LLC v. Motorola Solutions, Inc. (2:23-cv-00030-JRG-RSP, E. D. Tex.). 04/2024-01/2025.
- A deposition and trial testimony in WSOU Investments, LLC v. Cisco Systems, Inc. (6:20-cv-00128-ADA, W. D. Tex.). 03/2021-02/2025.

- A deposition and trial testimony in Touchstream Technologies, Inc. v. Comcast Cable Communications, LLC (2:23-cv-00062-JRG, E. D. Tex.). 01/2024-03/2025.
- A deposition and trial testimony in VidStream, LLC v. X, formerly Twitter, Inc. (3:16-cv-0764-N, N. D. Tex.). 07/2016-04/2025.
- Depositions in Western Digital Technologies, Inc. v. Viasat, Inc. (4:22-cv-4376-HSG, N. D. Cal.). 08/2022-05/2025.
- Depositions in Video Solutions PTE. LTD. v. Cisco Systems, Inc. (2:23-cv-222-JRG, E. D. Tex.). 08/2023-05/2025.
- Trial testimony in Adeia Guides, Inc. v. Bell Canada, Inc. (T-1184-21, Canada Federal Court). 01/2022-05/2025.
- A deposition in Certain Smart Televisions (ITC Inv. No. 337-TA-1420). [Maxell, Ltd. v. TCL Multimedia Technology Holdings, Ltd.]. 12/2024-06/2025.
- Trial testimony in The Nielsen Company (US), LLC v. Hyphametrics, Inc. (23-126-GBW-CJB, D. Del.). 10/2023-07/2025.
- A deposition in Plus One, LCC v. Capital Relocation Services, LLC (23-cv-2016-KMM-JFD, D. Minn.). 06/2024-07/2025.
- A deposition in Inter Partes Review of U.S. Patent No. 7,924,802 (IPR2024-01336) [Qualcomm, Inc. v. Cobblestone Wireless LLC]. 08/2024-09/2025.
- A deposition in Beijing Meishe Network Technology Co. LTD. v. TikTok, Inc. (5:23-cv-6012-SI, N. D. Cal.). 05/2023-08/2025.
- Trial testimony in Contour IP Holding, LLC v. GoPro, Inc. (17-cv-04738-WHO, N. D. Cal.). 10/2019-10/2025.
- Depositions in Inter Partes Review of U.S. Patent Nos. 8,875,185 (IPR2024-01338), 9,317,597 (IPR2024-01339), 8,145,704 (IPR2024-01340), 9,215,261 (IPR2024-01341), 8,886,753 (IPR2024-01342), and 9,923,947 (IPR2024-01343) [TikTok, Inc. v. NTECH Properties, Inc.]. 04/2024-10/2025.
- A deposition and trial testimony in Express Mobile, Inc. v. GoDaddy.com, LLC (1:19-cv-01937-RGA, D. Del.). 05/2020-11/2025.
- A deposition in Inter Partes Review of U.S. Patent No. 11,973,731 (IPR2024-01489 and IPR2024-01490) [Slack Technologies, LLC and Salesforce, Inc. v. Wrinkl, Inc.]. 01/2025-11/2025.
- A deposition and trial testimony in BARCO, Inc. v. YeaLink Network Technology Co., LTD (2:23-cv-00521-JRG-RSP, E. D. Tex.). 06/2024-11/2025.
- A deposition and trial testimony in SmartSky Networks, LLC v. Gogo Business Aviation, LLC (22-266-VAC, D. Del.). 12/2023-11/2025.
- Trial testimony in MyChoice, LLC and BarBoards, LLC v. Taiv, Inc. (2:23-cv-00507-JRG-RSP, E. D. Tex.). 04/2025-12/2025.

- A deposition in Certain Wi-Fi Routers, Wi-Fi Devices, Mesh Wi-Fi Network Devices and Components Thereof (US ITC Inv. No. 337-TA-1454) [Estelgia, LLC v. Plume Design Inc.]. 07/2025-03/2026.
- A deposition in Motorola Solutions, Inc. v. Hytera Communications Corp. LTD (1:17-cv-01972, N. D. Ill.). 04/2017-present.
- Depositions and trial testimony in Luminati Networks Ltd. v. UAB Tesonet and UAB Metacluster LT (2:18-cv-00299-JRG, E. D. Tex.); Luminati Networks Ltd. v. Teso LT, UAB; Oxysales, UAB; and Metacluster LT, UAB, (2:19-cv-00395-JRG, E. D. Tex.); Luminati Networks Ltd. v. Code 200, UAB; Oxysales, UAB; and Metacluster LT, UAB (2:19-cv-00396-JRG, E. D. Tex.); Bright Data Networks Ltd. v. Tefincom S.A. (2:19-cv-00414-JRG, E. D. Tex.); Metacluster LT, UAB v. Bright Data Ltd. (2:23-cv-00011-JRG-RSP, E. D. Tex.); Bright Data Ltd. v. Oxylabs, UAB (2:23-cv-00171-JRG-RSP, E. D. Tex.). 06/2020-present.
- A deposition in Zilkr Cloud Technologies, LLC v. Cisco Systems, Inc. (2:22-cv-00166-JRG-RSP, E. D. Tex.). 02/2023-present.
- A deposition in STA Group, LLC v. Motorola Solutions, Inc. (2:22-cv-00381-JRG-RSP, E. D. Tex.). 05/2023-present.
- A deposition in NEC Corporation v. Peloton Interactive, Inc. (1-22-cv-00987-CJB, D. Del.). 08/2023-present.
- A deposition in Robocast, Inc. v. Netflix, Inc. (1:22-cv-00305-RGA, D. Del.). 07/2022-present.
- Depositions in Time Warner Cable Enterprises, LLC v. Nokia of America Corp. (650748/2022, IAS Part 43, N. Y. and 654900/2022, IAS Part 43, N. Y.). 01/2024-present.
- A deposition in Charter Communications, LLC v. Sonus Networks, Inc. and Ribbon Communications Operating Company, Inc. (N22C-09-529-EMD-CCLD, DE and 653435/2022, Part 49, N. Y.). 01/2024-present.
- A deposition in Stellar LLC v. Motorola Solutions, Inc. and Watchguard Video, Inc. (4:23-cv-750-SDJ, E. D. Tex.). 01/2024-present.
- A deposition in Inter Partes Review of U.S. Patent Nos. 10,407,026 (IPR2024-00785), 9,171,268 (IPR2024-00786), 11,396,244 (IPR2024-00814), 9,365,188 (IPR2024-00981), 11,738,659 (IPR2024-001167), 11,104,245 (IPR2026-00059), 12,337,716 (IPR2026-00070), and 12,337,715 (PGR2026-00008) [Toyota Motor Corp and Kia Corp v. Emerging Automotive LLC]. 11/2023-present.
- A deposition in Warner Records, Inc. et al. v. Altice USA, Inc. (2:23-cv-00576-JRG-RSP, E. D. Tex.). 09/2024-present.
- A deposition in Cal Bridge, Inc. v. OneCal (1:24-cv-22361, S. D. Fla.). 03/2025-present.
- Depositions in Inter Partes Review of U.S. Patent Nos. 10,762,002 (IPR2024-01436), 11,403,237 (IPR2024-01437), 11,258,676 (IPR2024-01438), 11,422,951 (IPR2024-01439), 10,684,972 (IPR2025-00491), 11,966,346 (IPR2025-00597) and 11,966,347 (IPR2025-00598) [YeaLink Network Technology Co., LTD v. BARCO N. V.]. 06/2024-present.

- A deposition in Audio Pod IP, LLC v. Amazon.com, Inc. (3:24-cv-00406-RCY, E. D. Va.). 05/2025-present.
- A deposition in Voxtur Analytics Corp v. AutomationRE, Inc. (1:25-cv-742-GBW, D. Del.). 07/2025-present.
- A deposition in Sonos, Inc. v. Google, LLC (2:20-cv-00169-JAK, C. D. Cal.). 03/2025-present.
- A deposition in SoftEx, LLC v. Absolute Software Corp (1:22-cv-1308-DAE, W. D. Tex.). 10/2022-present.
- A deposition in Adaptive Spectrum and Signal Alignment, Inc. v. Charter Communications, Inc. et al. (2:24-cv-00124-JRG-RSP, E. D. Tex.). 04/2024-present.
- A deposition in AutoConnect Holdings, LLC v. Toyota Motor Corp and General Motors, LLC (2:24-cv-00802-JRG-RSP and 2:24-cv-00877-JRG-RSP, E. D. Tex.). 04/2025-present.
- A deposition in Oracle America, Inc. and Oracle International Corporation v. Procore Technologies, Inc. (4:24-cv-07457-JST, N. D. Cal.). 04/2025-present.
- A deposition in Audio Pod IP, LLC v. Audible, Inc. (2:25-cv-02198-MEF-AME, D. N. J.).3:24-cv-00406-RCY, E. D. Va.). 05/2025-present.