EX 1003

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Fortinet, Inc.,

Petitioner,

v.

Netskope, Inc.,

Patent Owner.

Case No. 2026-00026

U.S. Patent 8,327,426

DECLARATION OF DR. KEVIN C. ALMEROTH IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW U.S. PATENT NO. 8,327,426

FORTINET EX1003 Page 1

TABLE OF CONTENTS

TABLE OF ABBREVIATIONS

Abbreviation	Full Name
'426 Patent	U.S. Patent No. 8,327,426
Challenged Claims	Claims 1-13 of the '426 Patent
Patent Owner	Patent Owner Netskope, Inc.
Petitioner	Petitioner Fortinet, Inc.
POSITA	Person of Ordinary Skill In The Art

FORTINET EX1003 Page 9

EXHIBIT LIST

Exhibit No.	Document
1001	U.S. Patent No. 8,327,426 ("the '426 patent")
1002	File History of the '426 patent
1003	Declaration of Dr. Kevin Almeroth.
1004	U.S. Patent Pub. No. 2006/0021019 to Hinton et al. ("Hinton")
1005	U.S. Patent Pub. No. 2007/0234408 to Burch et al. ("Burch")

I, Kevin Almeroth, declare as follows:

I. INTRODUCTION

1. I have been retained on behalf of Fortinet, Inc. for the above-captioned inter partes review ("IPR"). I am being compensated for my time in connection with these IPRs at my standard hourly consulting rate. My compensation is in no way dependent upon my testimony or the outcome of the IPR.

2. I understand that this IPR involves U.S. Patent No. 8,327,426 ("the '426 patent" or "the Challenged Patent"). The Challenged Patent is titled "Single Sign On With Proxy Services." The named inventors are Stephen Hugh Kinser, Lloyd Leon Burch, and Cameron Craig Morris. I understand that it is assigned to Patent Owner Netskope, Inc. ("Patent Owner").

3. I have reviewed and am familiar with the specification of the Challenged Patent, which I understand to have been attached as Exhibit 1001. I have also reviewed and am familiar with the file history for the Challenged Patent, which I understand to have been provided as Ex. 1002. I understand that the Challenged Patent was filed June 1, 2006, and I have been asked to assume that date for the purposes of my analysis. I have not been asked to consider whether the patent is actually entitled to that date. My analysis would not change if the patent were not entitled to that date.

4. In preparing this declaration, I have also reviewed and am familiar with the following prior art used in the petition for *inter partes* review of the Challenged Patent:

a. U.S. Patent Pub. No. 2006/0021019 to Hinton et al. ("Hinton")- Ex. 1004; and

b. U.S. Patent Pub. No. 2007/0234408 to Burch et al. ("Burch") - Ex. 1005.

5. I have been asked to provide my technical review, analysis, insights, and opinions regarding the Challenged Patents and the above-noted references that form the basis for the grounds of rejection set forth in the petition for *inter partes* review of the Challenged Patent.

II. QUALIFICATIONS

6. I am currently a Professor Emeritus in the Department of Computer Science at the University of California, Santa Barbara (UCSB). While at UCSB, I held faculty appointments and was a founding member of the Computer Engineering (CE) Program, Media Arts and Technology (MAT) Program, and the Technology Management Program (TMP). I also served as the Associate Director of the Center for Information Technology and Society (CITS) from 1999 to 2012. I have been a faculty member at UCSB since July 1997.

7. I hold three degrees from the Georgia Institute of Technology: (1) a

Bachelor of Science degree in Information and Computer Science (with minors in Economics, Technical Communication, and American Literature) earned in June 1992; (2) a Master of Science degree in Computer Science (with specialization in Networking and Systems) earned in June 1994; and (3) a Doctor of Philosophy (Ph.D.) degree in Computer Science (Dissertation Title: Networking and System Support for the Efficient, Scalable Delivery of Services in Interactive Multimedia System, minor in Telecommunications Public Policy) earned in June 1997. During my education, I took a wide variety of courses, as demonstrated by my minors. My undergraduate degree also included a number of courses more typical of a degree in electrical engineering, including digital logic, signal processing, and telecommunications theory.

8. One of the major concentrations of my research over the past 30+ years has been the delivery of multimedia content and data between computing devices, including through various network architectures. In my research, I have studied large-scale content delivery systems and the use of servers located in a variety of geographic locations to provide scalable delivery to hundreds or thousands of users simultaneously. I have also studied smaller-scale content delivery systems in which content is exchanged between individual computers and portable devices. My work has emphasized the exchange of content more efficiently across computer networks, including the scalable delivery of content to

many users, mobile computing, satellite networking, delivering content to mobile devices, and network support for data delivery in wireless networks.

9. In 1992, the initial focus of my research was on the provision of interactive functions (e.g., VCR-style functions like pause, rewind, and fast-forward) for near video-on-demand systems in cable systems; in particular, how to aggregate requests for movies at a cable head-end and then how to satisfy a multitude of requests using one audio/video stream broadcast to multiple receivers simultaneously. This research has continually evolved and resulted in the development of techniques to scalably deliver on-demand content, including audio, video, web documents, and other types of data, through the Internet and over other types of networks, including over cable systems, broadband telephone lines, and satellite links.

10. An important component of my research has been investigating the challenges of communicating multimedia content, including video, between computers and across networks, including the Internet. Although the early Internet was used mostly for text-based, non-real-time applications, the interest in sharing multimedia content, such as video, quickly developed. Multimedia-based applications ranged from downloading content to a device to streaming multimedia content to be instantly used. One of the challenges was that multimedia content is typically larger than text-only content, but there are also

opportunities to use different delivery techniques since multimedia content is more resilient to errors. I have worked on a variety of research problems and used a number of systems that were developed to deliver multimedia content to users. One content-delivery method I have researched is the one-to-many communication facility called "multicast," first deployed as the Multicast Backbone, a virtual overlay network supporting one-to-many communication. Multicast is one technique that can be used on the Internet to provide streaming media support for complex applications like video-on-demand, distance learning, distributed collaboration, distributed games, and large-scale wireless communication. The delivery of media through multicast often involves using Internet infrastructure, devices, and protocols, including protocols for routing and TCP/IP.

11. Starting in 1997, I worked on a project to integrate the streaming media capabilities of the Internet with the interactivity of the web. I developed a project called the Interactive Multimedia Jukebox (IMJ). Users would visit a web page and select content to view. The content would then be scheduled on one of a number of channels, including delivery to students in Georgia Tech dorms, delivered via the campus cable plant. The content of each channel was delivered using multicast communication.

12. In the IMJ, the number of channels varied depending on the

capabilities of the server, including the available bandwidth of its connection to the Internet. If one of the channels was idle, the requesting user would be able to watch their selection immediately. If all channels were streaming previously selected content, the user's selection would be queued on the channel with the shortest wait time. In the meantime, the user would see what content was currently playing on other channels, and because of the use of multicast, would be able to join one of the existing channels and watch the content at the point it was currently being transmitted.

13. The IMJ service combined the interactivity of the web with the streaming capabilities of the Internet to create a jukebox-like service. It supported true Video-on-Demand when capacity allowed, but scaled to any number of users based on queuing requested programs. As part of the project, we obtained permission from Turner Broadcasting to transmit cartoons and other short-subject content. We also connected the IMJ into the Georgia Tech campus cable television network so that students in their dorms could use the web to request content and then view that content on one of the campus's public access channels.

14. More recently, I have also studied issues concerning how users choose content, especially when considering the price of that content. My research has examined how dynamic content pricing can be used to control system load. By raising prices when systems start to become overloaded (i.e., when all available

resources are fully utilized) and reducing prices when system capacity is readily available, users' capacity to pay as well as their willingness can be used as factors in stabilizing the response time of a system. This capability is particularly useful in systems where content is downloaded or streamed to users on demand.

15. As a parallel research theme, starting in 1997, I began researching issues related to wireless devices and sensors. In particular, I was interested in showing how to provide greater communication capability to "lightweight devices," i.e., small form-factor, resource-constrained (e.g., CPU, memory, networking, and power) devices. Starting in 1998, I published several papers on my work to develop a flexible, lightweight, battery-aware network protocol stack. The lightweight protocols we envisioned were similar in nature to protocols like Bluetooth, Universal Plug and Play (UPnP), and Digital Living Network Alliance (DLNA).

16. From this initial work, I have made wireless networking—including ad hoc, mesh networks and wireless devices—one of the major themes of my research. My work in wireless networks spans the protocol stack from applications through to the encoding and exchange of data at the data link and physical layers.

17. At the application layer, even before the large-scale "app stores" were available, my research looked at building, installing, and using apps for a variety

of purposes, from network monitoring to support for traditional computer-based applications (e.g., content retrieval) to new applications enabled by ubiquitous, mobile devices. For example, my research has looked at developing applications for virtually exchanging and tracking "coupons" through "opportunistic contact" among mobile wireless devices (i.e., communication among devices moving into communication range with each other). In many of the courses I have taught, there is a project component. Through these projects, I have supervised numerous efforts to develop new "apps" for download and use across a variety of mobile platforms.

18. Toward the middle of the protocol stack, my research has also looked to build wireless infrastructure support to enable communication among a set of mobile devices unaided by any other kind of network infrastructure. These kinds of networks are useful either in challenged network environments (e.g., when a natural disaster has destroyed existing infrastructure) or when suitable support for network communication never existed. The deployment of such networks (or even the use of traditional network support) is critical to support services like disaster relief, catastrophic event coordination, and emergency services deployment.

19. Yet another theme is monitoring wireless networks, in particular different variants of IEEE 802.11 compliant networks, to (1) understand the

operation of the various protocols used in real-world deployments, (2) use these measurements to characterize use of the networks and identify protocol limitations and weaknesses, and (3) propose and evaluate solutions to these problems. I have successfully used monitoring techniques to study wireless data link layer protocol operation and to improve performance by enhancing the operation of such protocols. For wireless protocols, this research includes functions like network acquisition and channel bonding.

20. One theme in my wireless network research has been cross-layer solutions and innovations. As mentioned above, with greater wireless device use and network support, we envisioned new application paradigms and services, for example, when mobile devices come into contact with each other. Instead of relying on existing infrastructure to relay communication, the devices are able to discover each other and communicate directly. Other examples include discovering and using location information to enhance users' experiences. Network support and novel applications use a variety of network architectures supporting users on foot, in vehicles, and across varying terrains and environments. Finally, we studied how communication efficiency can be supported through intelligent handoffs as well as location and movement prediction.

21. Protecting networks, including their operation and content, has been

an underlying theme of my research almost from the beginning of my career. Starting in 2000, I have been involved in several projects that specifically address security, network protection, and firewalls. After significant background work, a team on which I was a member successfully submitted a $4.3M grant proposal to the Army Research Office (ARO) at the Department of Defense to propose and develop a high-speed intrusion detection system. Key aspects of the system included associating streams of packets and analyzing them for viruses and other malware. Once the grant was awarded, we spent several years developing and meeting the milestones of the project. A number of my students worked on related projects and published papers on topics ranging from intrusion detection to developing advanced techniques to be incorporated into firewalls. I have also used firewalls, including their associated malware detection features, in developing techniques for the classroom to ensure that students are not distracted by online content.

22. My recent work ties some of the various threads of my past research together. I have investigated content delivery in online social networks and proposed reputation management systems in large-scale social networks and marketplaces. On the content delivery side, I have looked at issues of caching and cache placement, especially when the content being shared and the cache have geographical relevance. We were able to show that effective caching strategies

can greatly improve performance and reduce deployment costs. Our work on reputation systems showed that reputations have economic value, and as such, create a motivation to manipulate reputations. In response, we developed a variety of solutions to protect the integrity of reputations in online social networks. The techniques we developed for content delivery and reputation management were particularly relevant in peer-to-peer communication and recommendations for downloadable "apps."

23. As an important component of my research program, I have been involved in the development of academic research into available technology in the marketplace. One aspect of this work is my involvement in the Internet Engineering Task Force (IETF). The IETF is a large and open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. I have been involved in various IETF groups, including many content delivery-related working groups like the Audio Video Transport (AVT) group, the MBone Deployment (MBONED) group, the Source Specific Multicast (SSM) group, the Inter-Domain Multicast Routing (IDMR) group, the Reliable Multicast Transport (RMT) group, the Protocol Independent Multicast (PIM) group, etc. I have also served as a member of the Multicast Directorate (MADDOGS), which oversaw the standardization of all things related to multicast in the IETF. Finally,

I was the Chair of the Internet2 Multicast Working Group for seven years.

24. My involvement in the research community extends to leadership positions for several academic journals and conferences. I am the co-chair of the Steering Committee for the ACM Network and System Support for Digital Audio and Video (NOSSDAV) workshop and on the Steering Committees for the International Conference on Network Protocols (ICNP), ACM Sigcomm Workshop on Challenged Networks (CHANTS), and IEEE Global Internet (GI) Symposium. I have served or am serving on the Editorial Boards of IEEE/ACM Transactions on Networking, IEEE Transactions on Mobile Computing, IEEE Network, ACM Computers in Entertainment, AACE Journal of Interactive Learning Research (JILR), and ACM Computer Communications Review. I have co-chaired a number of conferences and workshops including the IEEE International Conference on Network Protocols (ICNP), IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), International Conference on Communication Systems and Networks (COMSNETS), IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS), the International Workshop On Wireless Network Measurement (WiNMee), ACM Sigcomm Workshop on Challenged Networks (CHANTS), the Network Group Communication (NGC) workshop, and the Global Internet Symposium, and I have served on the program

committees for numerous conferences.

25. Furthermore, in the courses I taught at UCSB, a significant portion of my curriculum covered aspects of the Internet and network communication including the physical and data link layers of the Open System Interconnect (OSI) protocol stack, and standardized protocols for communicating across a variety of physical media such as cable systems, telephone lines, wireless, and high-speed Local Area Networks (LANs). The courses I have taught also cover most major topics in Internet communication, including data communication, multimedia encoding, and mobile application design. My research and courses have covered a range of physical infrastructures for delivering content over networks, including cable, Integrated Services Digital Network (ISDN), Ethernet, Asynchronous Transfer Mode (ATM), fiber, and Digital Subscriber Line (DSL). For a complete list of courses I have taught, see my curriculum vitae (CV).

26. In addition, I co-founded a technology company called Santa Barbara Labs that was working under a subcontract from the U.S. Air Force to develop very accurate emulation systems for the military's next-generation internetwork. Santa Barbara Labs' focus was on developing an emulation platform to test the performance characteristics of the network architecture in the variety of environments in which it was expected to operate, and, in particular, for network services including IPv6, multicast, Quality of Service (QoS), satellite-based

communication, and security. Applications for this emulation program included communication of a variety of multimedia-based services, including video conferencing and video-on-demand.

27. In addition to having co-founded a technology company myself, I have worked for, consulted with, and collaborated with companies for nearly 30 years. These companies range from well-established companies to start-ups and include IBM, Hitachi Telecom, Turner Broadcasting System (TBS), Bell South, Digital Fountain, RealNetworks, Intel Research, Cisco Systems, and Lockheed Martin.

28. Through my graduate education, leadership with CITS, involvement in TMP, role in the development of the Internet2 infrastructure, and consulting with ISPs, I have gained a strong understanding of the role of the Internet in our society and the challenges of deploying large-scale production networking infrastructure. CITS, since its inception, has looked at the role of the Internet in society, including how the evolution of technology has created communication opportunities and challenges, including, for example, through disruptive technologies like P2P. TMP looks to focus on non-technical issues, including, for example, state-of-the-art business methods, strategies for successful technology commercialization, new venture creation, and best practices for fostering innovation. Through my industry collaborations and Internet2 work, I have

developed significant experience in the challenges of deploying, monitoring, managing, and scaling communication infrastructure to support evolving Internet services like streaming media, conferencing, content exchange, social networking, and e-commerce.

29. I am a Member of the Association of Computing Machinery (ACM) and a Fellow of the Institute of Electrical and Electronics Engineers (IEEE).

30. Additional details about my employment history, fields of expertise, courses taught, and publications are further included in my CV attached as Appendix A to this Report.

III. LEGAL STANDARDS

31. In forming my opinions and considering the subject matter of the patent and its claims in light of the prior art, I am relying on certain legal principles that counsel in this case explained to me. My understanding of these concepts is summarized below.

32. I understand that earlier publications and patents may act to render a patent unpatentable for one of two reasons: (1) anticipation, and (2) obviousness.

A. Anticipation

33. As explained to me by counsel, the claims of a patent are anticipated by a prior art reference if each and every element of the claim is found either explicitly or inherently in the reference. I understand that inherency requires a

showing that the missing descriptive matter in the claim is necessarily present in the allegedly anticipating reference, and that it would have been so recognized by a person of ordinary skill in the art ("POSITA").

34. I understand that when a challenged claim covers several structures, either generically or as alternatives, the claim is deemed anticipated if any of the structures within the scope of the claim are found in the prior art reference.

35. Although anticipation typically involves the analysis of a single prior art reference, I understand that additional references may be used to show that the prior art reference has enabling disclosure (i.e., allows a POSITA to make the invention without undue experimentation), to explain the meaning of a term used in the prior art reference, and/or to show that a characteristic is inherent in the prior art reference.

B. Obviousness

36. As explained to me by counsel, a claim is invalid as obvious if it would have been obvious to a POSITA at the time the alleged invention was made. This means that even if all of the elements of the claim cannot be found in a single prior art reference that would anticipate the claim, a POSITA who was aware of the prior art would have been able to come up with the claimed invention. This may be the case, for example, where the missing element represents only an insubstantial difference over the prior art or a reconfiguration of a known system. I

understand that in an obviousness determination, the POSITA is presumed to have knowledge of all material prior art.

37. I understand that an obviousness analysis requires an understanding of the scope and content of the prior art, any differences between the alleged invention and the prior art, and the level of ordinary skill in evaluating the pertinent art.

38. I understand that when a product is available, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a POSITA can implement a predictable variation, obviousness likely bars its patentability. For the same reason, if a technique has been used to improve one device and a POSITA would recognize that it would improve similar devices in the same way, using the technique would have been obvious.

39. I understand that whether a prior art reference renders a patent claim unpatentable as obvious is determined from the perspective of a POSITA at the time of the alleged invention. I have been told that there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, but a suggestion to combine known elements to achieve the claimed invention may come from the prior art, as filtered through the knowledge of one skilled in the art. In addition, I have been told that the inferences and creative steps a POSITA would employ are relevant to the determination of

obviousness.

40. I understand that one may consider, e.g., whether (1) the change was merely the predictable result of using prior art elements according to their known functions, or whether it was the result of true inventiveness; (2) there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; (3) the claimed innovation applies a known technique that had been used to improve a similar device or method in a similar way; (4) the claimed invention would have been obvious to try, meaning that the claimed innovation was one of a relatively small number of possible approaches to the problem with a reasonable expectation of success by those skilled in the art; (5) the invention merely substituted one known element for another known element in order to obtain predictable results; (6) the invention merely applies a known technique to a known device, method, or product to yield predictable results; or (7) known work in one field of endeavor may have prompted variations of it for use in either the same field or a different one based on design incentives or other market forces that would have been predictable to a POSITA.

41. I further understand that certain factors may support or rebut the obviousness of a claim. I understand that such secondary considerations include, among other things, commercial success of the patented invention, skepticism of those having ordinary skill in the art at the time of the invention, unexpected

results of the invention, any long-felt but unsolved need in the art that was satisfied by the alleged invention, the failure of others to make the alleged invention, praise of the alleged invention by those having ordinary skill in the art, and copying of the alleged invention by others in the field. I understand that there must be a nexus—that is, a connection—between any such secondary considerations and the alleged invention. I also understand that contemporaneous and independent invention by others is a secondary consideration tending to show obviousness.

42. Additionally, I understand that in considering obviousness, it is important not to use the benefit of hindsight derived from the patent under consideration.

C. Level of Ordinary Skill in the Art

43. When interpreting a patent, I understand that it is important to identify the relevant art pertaining to that patent, as well as the level of ordinary skill in that art at the time of the claimed invention. The "art" is the field of technology to which the patent is related.

44. I am informed and understand that the POSITA is a hypothetical person who is presumed to know the relevant prior art. I understand that the actual inventor's skill is not determinative of the level of ordinary skill. I further understand that factors that may be considered in determining level of skill include: (i) the types of problems encountered in the art; (ii) prior art solutions to

those problems; (iii) the rapidity with which innovations are made; (iv) the sophistication of the technology; and (v) the educational level of active workers in the field. I understand that not all such factors may be present in every case, and one or more of them may predominate.

45. I understand that a POSITA is one who is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity.

D. Claim Construction

46. I understand that, in this IPR, the claims are interpreted consistent with the plain and ordinary meaning of the term as it would have had to a POSITA at the time of the alleged invention.

IV. THE STATE OF THE ART AND THE '426 PATENT

47. As I briefly lay out below, user accounts on the internet and single sign-on accounts have been around for many years. Although I am generally aware of the details surrounding the history, I focus below on only the particular points most relevant to this IPR.

A. User Accounts

48. As acknowledged by the patent, it was common for users to maintain several different accounts across various internet services. Ex. 1001 at 1:11-37. At the time the patent was filed, the standard method for accessing these accounts involved manually entering a username and password. It was already widely

understood that users should employ distinct passwords for each account, which posed a challenge—remembering numerous different passwords. I was personally familiar with the authentication procedures from the late 1990s and early 2000s.

B. Single Sign-On (SSO)

49. Single Sign-On (SSO) technology began to take shape in the 1980s. Its purpose was to allow organizations, including businesses and government entities, to streamline employee authentication by centralizing login credentials through an identity and access management (IAM) system. One example is the Lightweight Directory Access Protocol (LDAP), available by at least 1997, which became a widely adopted protocol for managing and retrieving distributed authentication data. *See* https://datatracker.ietf.org/doc/html/rfc2251. Additionally, during the 1990s, companies such as Microsoft launched commercial IAM tools like Active Directory and its earlier version, NT Directory Services. *See* https://news.microsoft.com/source/1999/06/03/microsoft-releases-active-directory-service-interfaces-2-5/. Again, I was personally familiar with SSO technologies, including LDAP and Active Directory, in the 1980s and 1990s.

C. Federated Architectures

50. Federated system architectures—which distribute control across to multiple systems or organizations—were already well established long before the '426 patent. As an example, the Security Assertion Markup Language (SAML)

was ratified in 2002 as a secure protocol for exchanging identity data across separate networks or systems. *See* https://www.oasis-open.org/2002/11/05/security-assertion-markup-language-saml-ratified-as-oasis-open-standard/. I was personally familiar with federated systems and SAML by at least 2002.

D. The '426 Patent

51. The '426 patent explains that as individuals and businesses increasingly engage in transactions and activities online, users are required to manage a growing number of accounts—each potentially needing a unique username and password. Ex. 1001 at 1:11–53. The patent illustrates this with a scenario in which a user attempts to make a purchase from a vendor using their bank account, but the user holds separate accounts with the vendor and the bank, and the two systems are not designed to communicate with one another. *Id.* at 1:29–32. As a result, the user might be unable to complete the transaction or may need to enroll in a third-party service that works with both the bank and the vendor. *Id.* at 1:33–37. The patent emphasizes a need for solutions that allow users to sign on for any network transaction, especially when the transaction involves the "proxing [sic] of services." *Id.* at 1:53–55.

52. To address the problem it identifies, the patent introduces the concept of an "identity service," which it defines as "a special type of service that is

designed to manage and supply authentication services and authentication information for principals and for other services." *Id.* at 2:33–36. The patent notes that multiple such identity services may be involved in handling user authentication. It further explains that an identity service can either "act as a proxy for a session" or "facilitate a session directly." *Id.* at 5:67–6:3.

53. Figure 5 shows one example of this. I added the coloring to help explain the process:

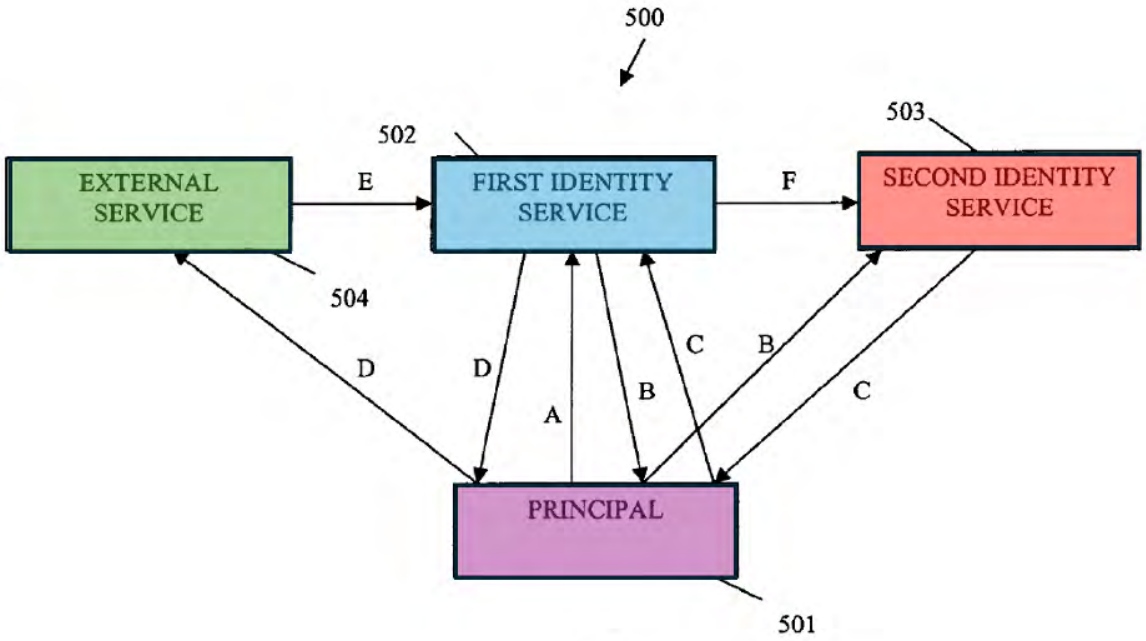


FIG. 5

54. The patent describes a scenario in which the principal **501** (e.g., a user) intends to access an external service **504**, such as by submitting a request through a web browser. Rather than contacting the external service directly, the user may first be redirected to authenticate through a first identity service **502**. *Id.*

at 10:17–24. At that point, the principal sends an authentication request to the first identity service via message A. *Id.* at 10:17–18. This first identity service then authenticates the principal using a suitable method, such as a challenge/response process. Following authentication, the first identity service automatically redirects the user's browser to a second identity service **503** via message B. *Id.* at 10:25–32.

55. The redirection message B sent to the second identity service signals that the principal has already been authenticated by the first identity service, as message B includes both an authentication request and its corresponding response. *Id.* at 10:33–40. Upon receiving this information, the second identity service treats the principal as authenticated. The second identity service then issues an authentication token to the principal through message C, which is also forwarded to the first identity service. *Id.* at 10:40–49.

56. The first identity service then forwards its own authentication statement or token together with the token received from the second identity service in message D. The principal can use this message to redirect to the external service. As a result, the external service will recognize that the principal has been authenticated by both the first and second identity services. *Id.* at 10:58–64.

57. Once the principal has been authenticated by the external service, they may seek to access a specific service offered by the second identity service. In this

case, the external service sends a request to the first identity service using message E. *Id.* at 10:64–11:2. The first identity service then attaches the appropriate authentication tokens for the principal and forwards the request to the second identity service via message F. In turn, the second identity service issues a service token that permits the principal to access the targeted service through a proxy. The patent states that this proxied access "can occur via the first identity service 502 or it can occur directly via the external service 504 interacting with the second identity service 503." *Id.* at 11:2–10. I note that the Challenged Claims require that the identity service "act as a proxy for access sessions to the other services on behalf of the principal."

E. The Challenged Claims

58. The '426 patent has 17 claims, but I understand that only claims 1-13 are challenged. I reproduced these below:

59. Claim 1 is described from the viewpoint of the machine operating as the first identity service depicted in Figure 5. Claim 8, which is the other independent Challenged Claim, is from the perspective of the machine with the second identity service from Figure 5.

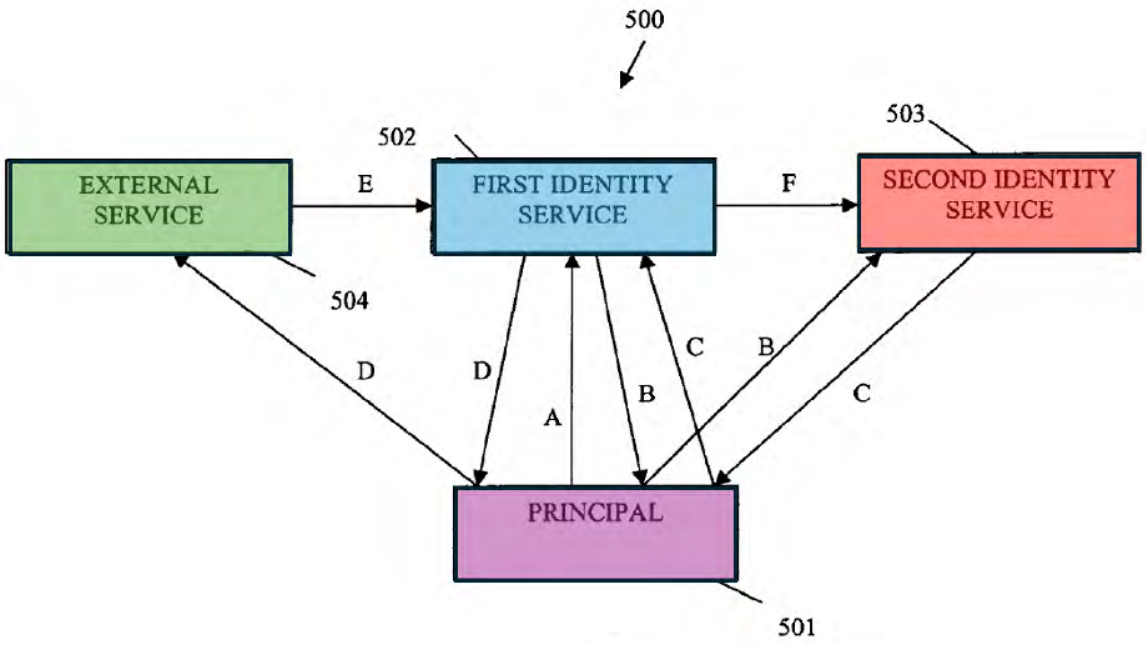


FIG. 5

1. A machine-implemented method to execute on a machine, comprising:

receiving, by the machine, an authentication request from a principal, the request directed by the principal to an external service and intercepted by the method for receipt;

authenticating, by the machine, the principal; and

supplying, by the machine, an authentication message for use by an identity service on behalf of the principal,

the authentication message serves as a new authentication request and as a new authentication response for single sign-on access of the principal to the identity service and other services external or internal to the identity service,

the identity service acts as a proxy for access sessions to the other services on behalf of the principal,

the principal's access sessions occur indirectly through the identity service and transparently to the principal,

wherein the authentication message includes the new authentication request made on behalf of the principal and the authentication

message also includes a new authentication response that satisfies the new authentication request,

that response vouches for authentication of the principal to the identity service for the single sign-on access of the principal,

the principal believing interactions are with the external service, which is one of the other services that the identity service controls access to, and

a determination as to whether to use a single interaction or multiple interactions for authentication of the principal to the other services is automatically communicated in the new authentication response.

2. The method of claim 1 further comprising, making, by the machine, a target service available to interactions between the principal and an external service, the target service is directly accessible from an environment of the identity service.

3. The method of claim 1, wherein supplying further includes redirecting the principal to the identity service and including with the redirection the new authentication request and the new authentication response represented by the authentication message, and the identity service authenticates the principal automatically in response to the new authentication response included with the authentication message.

4. The method of claim 3, wherein supplying further includes representing the new authentication response as a first authentication token that informs the identity service that the principal is currently already properly authenticated to the processing associated with the method.

5. The method of claim 4, wherein supplying further includes adding a second authentication to a second redirection of the principal, wherein the second authentication represents authentication of the principal to the identity service and wherein the second redirection directs the principal to request a target service that is to be proxied on behalf of the principal from the identity service.

6. The method of claim 1, wherein supplying further includes representing the new authentication response as an instruction to the identity service to enforce its own independent authentication with the principal before considering the principal authenticated to the identity service.

7. The method of claim 1 further comprising, interacting, by the machine, with the principal via a World-Wide Web (WWW) browser over the Internet using at least one of a Security Assertion Markup Language (SAML), a Liberty Alliance markup language, and Web Services (WS) Foundation markup language.

8. A machine-implemented method to execute on a machine, comprising:

receiving, by the machine, an authentication request and an authentication response as a single sign-on transaction from a principal,

the authentication request and the authentication response are received indirectly from the principal via an original identity service acting as a proxy on behalf of the principal and

actions of that original identity service are transparent to the principal and the authentication response produced by that original identity service to authenticate the principal for the single sign-on transaction,

the authentication request and the authentication response produced by the original identity service are different from that which was originally provided by the principal to the original identity service and

the authentication request and the authentication response are made on behalf of the principal once the principal is authenticated by the original identity service;

detecting, by a machine and from an identity service, an instruction, which is represented in the authentication response,

the identity service is different from the original identity service, and

the identity service and the original identity service are in a secure relationship with one another; and

taking, by the machine, an action in response to the instruction to authenticate the principal for access to targeted services,

access to the target services occur via proxied sessions through the identity service and transparent to the principal,

wherein the action taken is dynamic and a real-time evaluation of policies processed by the identity service.

9. The method of claim 8, wherein detecting further includes identifying the instruction as an assertion from the identity service that the principal is currently already authenticated to the identity service.

10. The method of claim 9, wherein taking further includes authenticating the principal, in response to the assertion, and supplying an authentication token to the principal indicating that the principal is authenticated for access to the targeted services.

11. The method of claim 8, wherein detecting further includes identifying the instruction as an identity service request from the identity service to independently authenticate the principal.

12. The method of claim 11, wherein taking further includes interactively authenticating the principal via a challenge and response dialogue in response to the identity service request and supplying an authentication token to the principal that indicates the principal is authenticated for access to the targeted services, if authentication is successful.

13. The method of claim 8 further comprising:

receiving, by the machine, an authentication service token from the identity service or an external service associated with the principal, the authentication service token indicates the principal has been authenticated for access to the targeted services, and the targeted services are external to the identity service; and

using, by the machine, the authentication service token to proxy the targeted services to the identity service or the external service associated with the principal transparent to the principal, access sessions between the principal and the target services are proxied via the identity service or the external service.

F. File History

60. I have reviewed the file history and have considered it in my analysis below. I have seen nothing in the file history that affects any of the opinions

expressed in this declaration.

61. I reserve the right to respond to any reliance on the file history by Patent Owner in an attempt to argue their claims are valid.

G. POSITA

62. In my opinion the pertinent field for the '426 patent falls within computer science broadly, and more specifically within computer security. It is my opinion that, as of June 2006, a person of ordinary skill in this field would have been someone with either (1) a bachelor's degree in computer science, computer engineering, or a related discipline along with at least one year of experience in computer security, or (2) a minimum of three years of practical experience in computer security without necessarily holding a formal degree.

63. Based on my knowledge, skill, and experience, I have an understanding of the capabilities of a person of ordinary skill in the relevant art. For example, from my industry experience, I am familiar with what an engineer would have knowledge of when dealing with computer security in the relevant time frame. From teaching and supervising undergraduate and graduate students, I also have an understanding of the knowledge that a POSITA would have. Furthermore, I possessed the knowledge of a POSITA myself at least as of June 2006.

V. CLAIM CONSTRUCTION

64. It is my opinion that no constructions are necessary as the prior art would disclose or render obvious the claims at issue under any reasonable construction or any term. To the extent Patent Owner attempts to offer specific, narrower constructions, I reserve the right to address those positions.

VI. REASONS FOR INVALIDITY

65. I have considered the following grounds of invalidity:

Ground	Claims	Basis	Prior Art
1	1-4, 6-11, 13	§ 102	Hinton
2	1-13	§ 103	Hinton
3	1-13	§ 103	Hinton over Burch

VII. GROUNDS 1 AND 2 – CLAIMS 1-4, 6-11, 13 ARE ANTICIPATED BY HINTON AND CLAIMS 1-13 ARE RENDERED OBVIOUS BY HINTON ALONE

A. Overview of Hinton

66. Hinton describes a federated provisioning system where a user, once authenticated through a single point-of-contact ("POC") server, can gain access to multiple domains. Figure 4 illustrates the architecture of this authentication method:

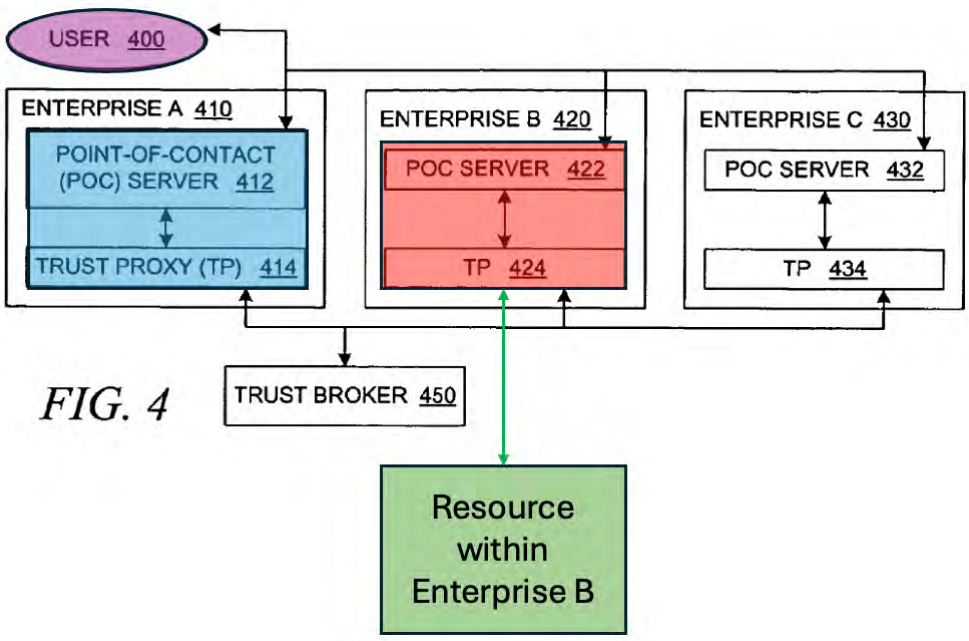


FIG. 4

67. The user **400** may initially authenticate with Enterprise A **410** (domain **410**) through the POC server **412**. Ex. 1004 at ¶ 155. The POC might utilize a trust proxy (TP) **414** to assist in the authentication process; however, the POC and TP can be housed on the same device. *Id.* at ¶ 106 ("It should be noted that although FIG. 2C depicts point-of-contact server **252**, trust proxy **254**, security token service component **255**, and authentication service runtime **256** as distinct entities, it is not necessary for these components to be implemented on separate devices"). After the user is authenticated with Enterprise A, subsequent logins may initiate a federated single sign-on operation. *Id.* at ¶ 156.

68. For instance, when a user attempts to access a resource within Enterprise B **420** (domain **420**), Enterprise A acts as the "issuing party," and Enterprise B serves as the "relying party." The POC and TP of Enterprise A

generate a federated single-sign-on token for the user, formatted to be accepted and trusted by Enterprise B. The POC **422** and TP **424** of Enterprise B then validate this token and create a session for the user within Enterprise B's domain, granting access to the requested resource. *Id.* at ¶ ¶ 156–157. Following authentication through Enterprise B's POC/TP, the user can continue accessing the resource via Enterprise B's POC, which enables the establishment of a federated session recognized by the domain's POC server. *Id.* at ¶ 94.

B. Claim 1

1. [1PRE]: "A machine-implemented method to execute on a machine, comprising:"

69. In my opinion, Hinton discloses a machine-implemented method that performs all of the claimed steps. For instance, Hinton explains that the POC 412 and TP 414 are implemented on a server and do not have to reside on separate devices. Ex. 1004 at ¶ 106. Throughout my analysis here, the POC/TP of Enterprise A serves as the "machine" executing the method described in claim 1. *Id*.

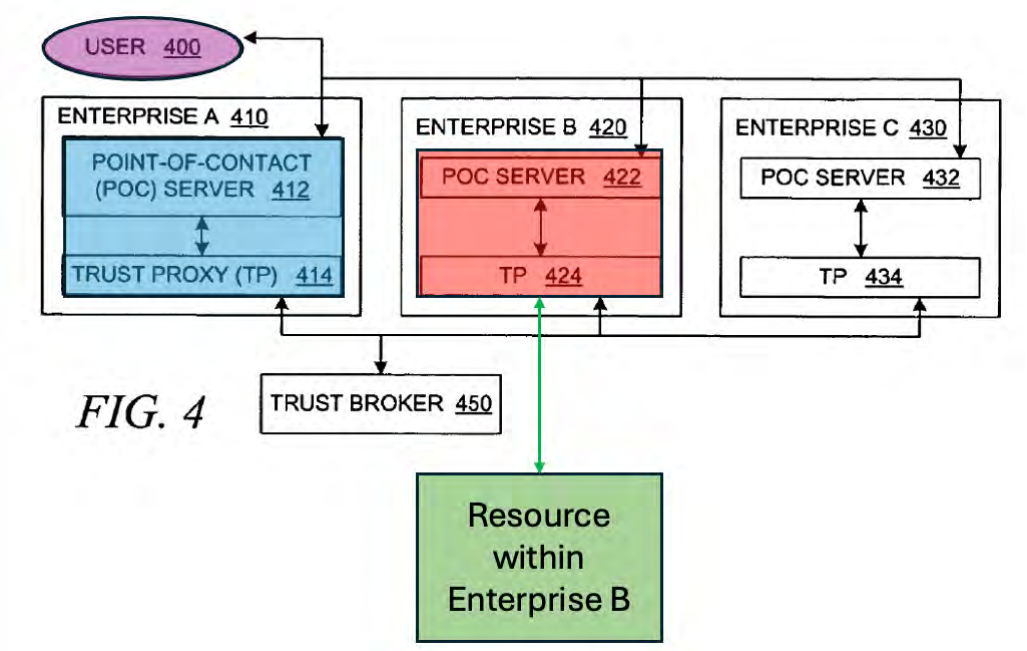


FIG. 4

2. [1A]: "receiving, by the machine, an authentication request from a principal, the request directed by the principal to an external service and intercepted by the method for receipt;"

70. I observe that Hinton describes that the POC/TP of Enterprise A—which is the machine executing the method—receives an authentication request from the user (i.e., the principal) seeking access to a resource located in the Enterprise B domain. For example, "the user may invoke a federated single-sign-on operation to a resource in domain **420** via point-of-contact server **412**, e.g., by selecting a special link on a web page that is hosted within domain **410** or by requesting a portal page that is hosted within domain **410** but that displays resources hosted in domain **420**." Ex. 1004 at ¶ 156. In this context, Enterprise A functions as the "issuing party," while Enterprise B acts as the "relying party."

71. It is my opinion that Hinton provides additional details about this

process in the flowchart presented in Figure 3D (and the associated description of Figure 3D in the specification).

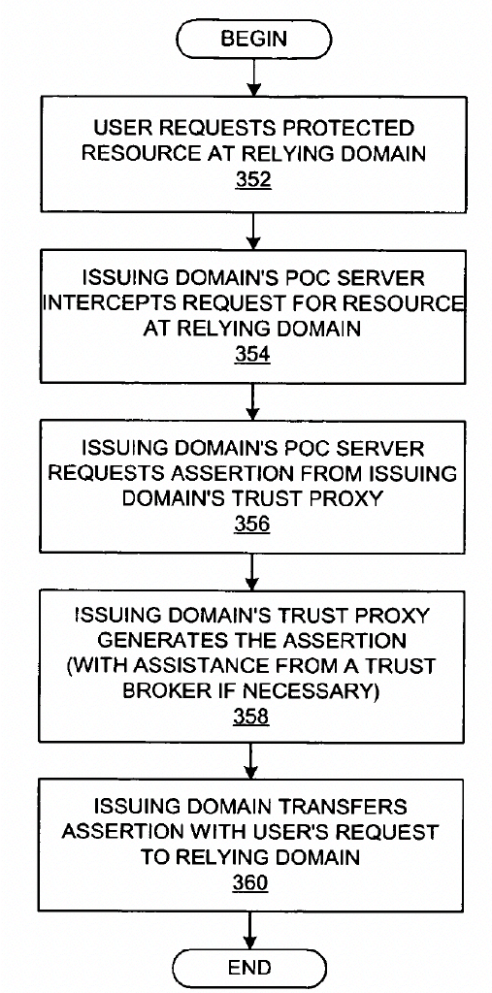


FIG. 3D

72. As illustrated above, when the user (i.e., the principal) attempts to access a protected resource within the relying domain (Enterprise B), the POC server in the issuing domain (Enterprise A) "actively intercept[s]" the request. *Id.* at ¶ 139. Thus, Hinton discloses that the system receives the user's request by intercepting it. *Id.*

3. [1B]: "authenticating, by the machine, the principal; and"

73. I note that Hinton describes that the POC/TP of Enterprise A—which is the machine executing the method—authenticates the user (i.e., the principal) for access to its domain by "validat[ing] the user's presented authentication credentials." Ex. 1004 at ¶ 155.

74. I further observe that Hinton also discloses that, upon receiving a request to access a resource in Enterprise B, the POC/TP "generate[s] a federation single-sign-on token" for the user. Ex. 1004 at ¶ 156. In my opinion, a POSITA would have understood that the system must authenticate the user before generating this federation token—at a minimum, to determine for whom the token is being issued.

75. Moreover, it is further my opinion that it would have been obvious to a POSITA to perform user authentication prior to generating the federation token, as the system would need to confirm that the user remains authorized and that their permissions have not been revoked since initially authenticating with the POC/TP of Enterprise A and prior to making the request for access to Enterprise B.

4. [1C]: "supplying, by the machine, an authentication message for use by an identity service on behalf of the principal,"

76. Hinton discloses that the POC/TP of Enterprise A provides a "federation single-sign-on token for the user that is formatted to be understood or

trusted by" the Enterprise B domain 420—effectively, an authentication message. Ex. 1004 at ¶ 156. Accordingly, this token is delivered by the POC/TP of Enterprise A on behalf of the user (i.e., the principal). In my opinion, a POSITA would have understood that this token would be included in an authentication message intended for the POC/TP of Enterprise B, which operates the identity service.

77. Since it is well understood that servers like the POCs communicate by transmitting messages, it is further my opinion that a POSITA reading Hinton would recognize that supplying authentication information from Enterprise A's POC/TP to Enterprise B's POC/TP must involve sending an authentication message between the two machines.

5. [1D]: "the authentication message serves as a new authentication request and as a new authentication response for single sign-on access of the principal to the identity service and other services external or internal to the identity service,"

78. As I explained for limitation [1C], Hinton discloses that the POC/TP of Enterprise A provides an authentication message to the POC/TP of Enterprise B (which functions as the identity service) on behalf of the user (i.e., the principal). Hinton specifies that this involves sending the "federation single-sign-on token" along with "the user's request" from Enterprise A's POC/TP to that of Enterprise B as part of an authentication message. Ex. 1004 at ¶ 156.

79. In my opinion, a POSITA would have understood that the user's initial request to the POC/TP of Enterprise A constitutes a first request, and the subsequent request sent from the POC/TP of Enterprise A to the POC/TP of Enterprise B is a distinct, separate message. It is my opinion that a POSITA would have understood that this distinction arises at least because the second request originates from the POC/TP of Enterprise A—the machine executing the method—rather than from the user (the principal).

80. And, it is my opinion that a POSITA would have understood that the token is the new authentication response.

81. Furthermore, in my opinion, to the extent a POSITA sought to better understand the structure of the new authentication message, they would rely on their general knowledge of how authentication messages are typically formatted. Applying that knowledge, it is my opinion that it would have been obvious to a POSITA that the token could function as both a new authentication request and a new authentication response. Specifically, the POSITA would recognize that the token must be structured to request access on behalf of the user (i.e., a new authentication request) from the POC/TP of Enterprise B (the identity service). At the same time, the token would need to contain valid credentials sufficient to authenticate the user with Enterprise B (i.e., a new authentication response). In my opinion, a POSITA would further understand that if the token lacked such

formatting, the POC/TP of Enterprise B would need to contact the user directly to obtain the necessary information—defeating the purpose of Hinton's "single-sign-on token." Thus, it is my opinion that it would have been apparent to a POSITA that because the token is generated by the POC/TP of Enterprise A, it represents a new and distinct authentication request and response.

6. [1E]: "the identity service acts as a proxy for access sessions to the other services on behalf of the principal,"

82. The POC/TP of Enterprise B—which is the machine operating the identity service—then functions as a proxy for the user's (principal's) access sessions. Following authentication through Enterprise B's POC/TP, Hinton discloses two possible scenarios: (1) the user accesses the requested resources directly, or (2) the user accesses the resources through Enterprise B's POC/TP, which acts as a proxy. For instance, Hinton notes that "the domain may be configured so that users may continue to access particular application servers or other protected resources directly without going through a point-of-contact server or other component implementing this point-of-contact server functionality." Ex. 1004 at ¶ 94. In the first scenario, Hinton explains that "a user that directly accesses the legacy system would not be able to establish a federated session that is known to the domain's point-of-contact server." *Id*. It is therefore my opinion that a POSITA would have understood that, in the second scenario—where the user continues accessing resources via the POC/TP of Enterprise B—the POC/TP

would be aware of the user's federated sessions. I depict this below.

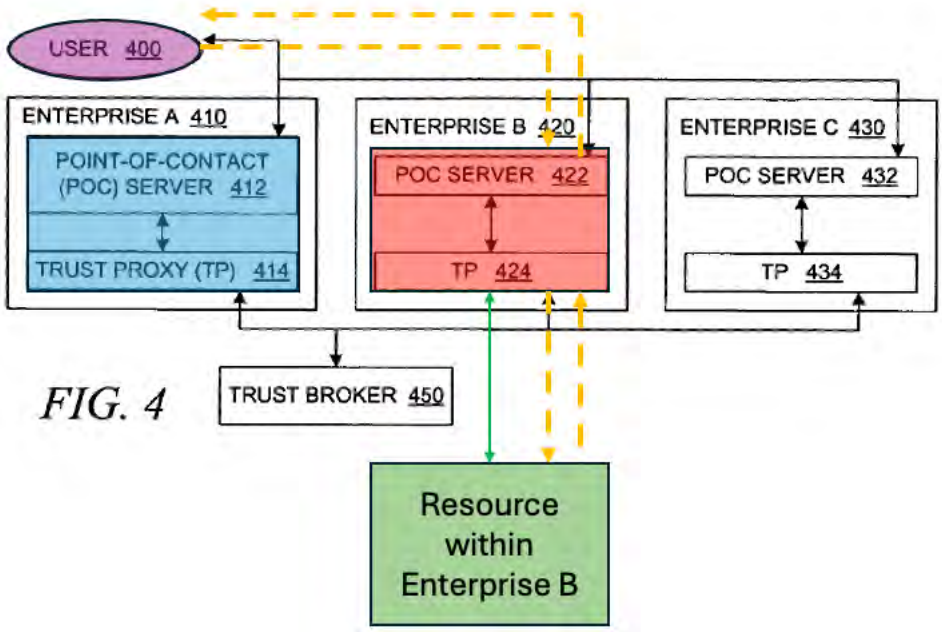


FIG. 4

83. Moreover, in my opinion, it would have been obvious to a POSITA that the POC of Enterprise B could continue functioning as a proxy for accessing resources within Enterprise B. For example, as shown in the reproduced Figure 4 above, once the user is authenticated, they would continue to access the resource through Enterprise B's POC server. This arrangement means that the POC server acts as a proxy for the user's access sessions to the resource. Positioned as an intermediary in these sessions, the POC server would be aware of and capable of managing the sessions, including actions such as limiting bandwidth or denying access if authentication is revoked during an active session. *See* Ex. 1004 at ¶ 94.

7. [1F]: "the principal's access sessions occur indirectly through the identity service and transparently to the principal,"

84. As I explained for limitation [1E], Hinton discloses, and/or it would have been obvious, that the POC/TP of Enterprise B (the identity service) functions as a proxy for access sessions to its resources. Accordingly, Hinton teaches that the communication flow—i.e., the access session—occurs from the user (i.e., the principal) to the service *indirectly* through the POC/TP of Enterprise B. *See* EX1004, ¶94.

85. In my opinion, a POSITA would also understand that, within the context of Hinton, the Enterprise B POC/TP operates transparently to users, meaning the user would be unaware that their access to resources is occurring indirectly.

8. [1G]: "wherein the authentication message includes the new authentication request made on behalf of the principal and the authentication message also includes a new authentication response that satisfies the new authentication request, that response vouches for authentication of the principal to the identity service for the single sign-on access of the principal,"

86. As I explained for [1C] and [1D], Hinton discloses, or it would have been obvious, that the authentication message comprises both a new authentication request (made on behalf of the user) and a corresponding new authentication response that satisfies that request (i.e., a single-sign-on token), as I

previously discussed with respect to limitations [1D] and [1C]. *See* EX1004, ¶156.

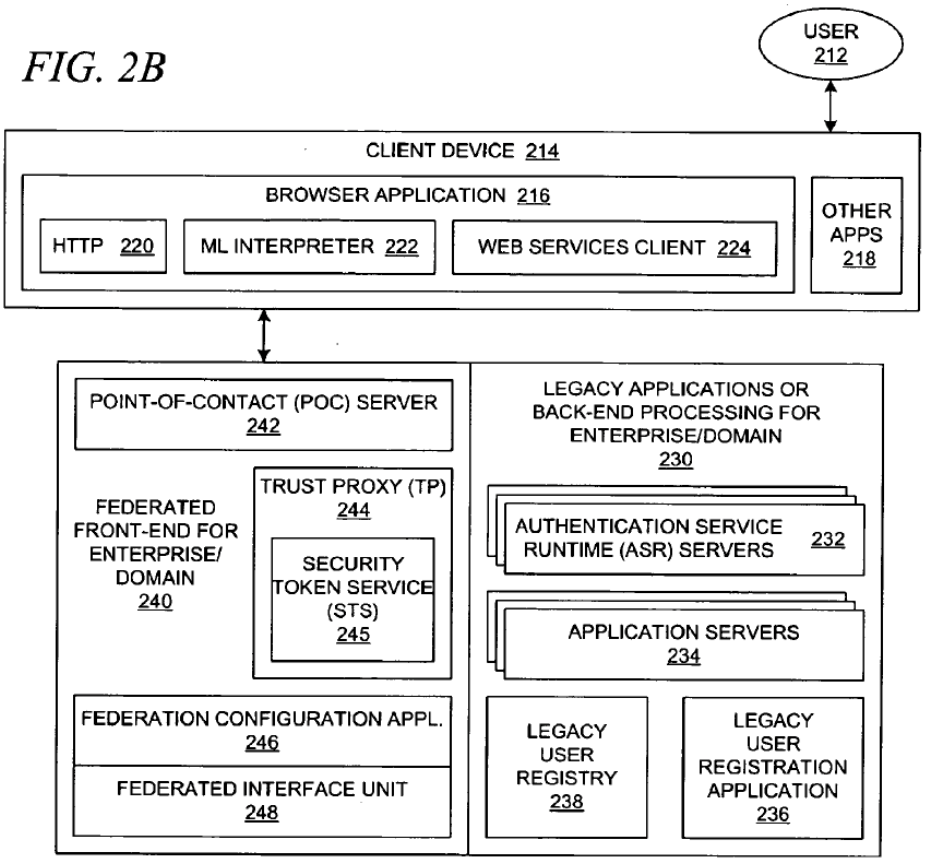
87. It is my opinion that a POSITA would have further understood that, through the new authentication request and new authentication response already described, the new authentication response satisfies the new authentication request, thereby vouching for the user at the Enterprise B POC/TP to enable the user's (principal's) single sign-on access. *Id.*

9. [1H]: "the principal believing interactions are with the external service, which is one of the other services that the identity service controls access to,"

88. The exact scope of "the principal believing interactions are with the external service" is unclear to me. I do note, however, that the '697 patent says: "The presence of the single sign-on service may be transparent or unknown to the principal. That is, the principal may believe that it is interacting or attempting to interact with an external service, while the single sign-on service intercepts the communication and attempts to authenticate the principal as described herein and below." Ex. 1001 at 4:9-12. As I explained in [1F], the user's access session in Hinton occurs transparently through the POC/TP of Enterprise B. It is therefore my opinion that the user from Hinton "may believe that it is interacting" with a resource in Enterprise B (the external service) and is thus within the scope of the limitation despite the fact that the bounds are unclear.

89. Hinton further discloses that the POC/TP of Enterprise B manages access to the applications and other resources within Enterprise B. For instance, Figure 2B (which I copied below) illustrates that the POC/TP controls access to "protected resources" of the enterprises, which may be hosted on application servers 234. Ex. 1004 at ¶ 93. Hinton defines a "protected resource" as a resource—such as an application, object, document, page, file, executable code, or other computational or communication resource—for which access is controlled or restricted. *Id.* at ¶ 61.

FIG. 2B



90. Furthermore, in my opinion, it would have been obvious to a POSITA

that the POC/TP of Enterprise B governs access to Enterprise B's resources. This aligns with the stated purpose of the POC/TP in Hinton, which explains that these components are utilized "for access control purposes." Ex. 1004 at ¶ 155. Additionally, it is my opinion that a POSITA would have recognized that the POC can manage access to resources both internal and external to Enterprise B.

10. [1I]: "and a determination as to whether to use a single interaction or multiple interactions for authentication of the principal to the other services is automatically communicated in the new authentication response."

91. Hinton teaches that the number of interactions needed for Enterprise B to authenticate the user "[d]epend[] on the type of token presented by domain 410." Ex. 1004 at ¶ 158. "For example, domain **[410]** may provide a binary Security token containing the user's name and password to be validated against the user registry at domain **420**." *Id.* I replaced the domain number here because it is my opinion that a POSITA would have understood the original number to be a typo because it would not make sense otherwise. In this case, only a single interaction is necessary, as the user's credentials are directly validated against Enterprise B's user registry.

92. Hinton further clarifies that "it is not always the case that the issuing domain will know how to map the user from a local identifier for domain 410 to a local identifier for domain 420." *Id.* at ¶ 160. In such situations, the Enterprise B

POC/TP must engage in multiple interactions with other components, such as the trust broker 450. *Id*.

93. In my opinion, a POSITA would have understood that the requirement for either a single or multiple authentication interactions is conveyed within the single sign-on token. The POC/TP of Enterprise B uses the information contained in the received token to determine whether one or two interactions are necessary by checking whether it received a binary Security token or a user name that must be mapped to the local identifier, which I described above.

94. As I previously stated, the number of interactions required for Enterprise B to authenticate the user depends on the type of token received by the Enterprise B POC/TP. If the single sign-on token is a binary security token requiring only one interaction, this fact is conveyed within the new authentication response. Conversely, if the issuing domain cannot map the user to a local identifier, that information would also be communicated in the new authentication response.

95. Moreover, it is my opinion that it would have been obvious to a POSITA that the POC/TP of Enterprise B selects between the two authentication methods described above based on the type of token it receives and the information available to the POC/TP of Enterprise B.

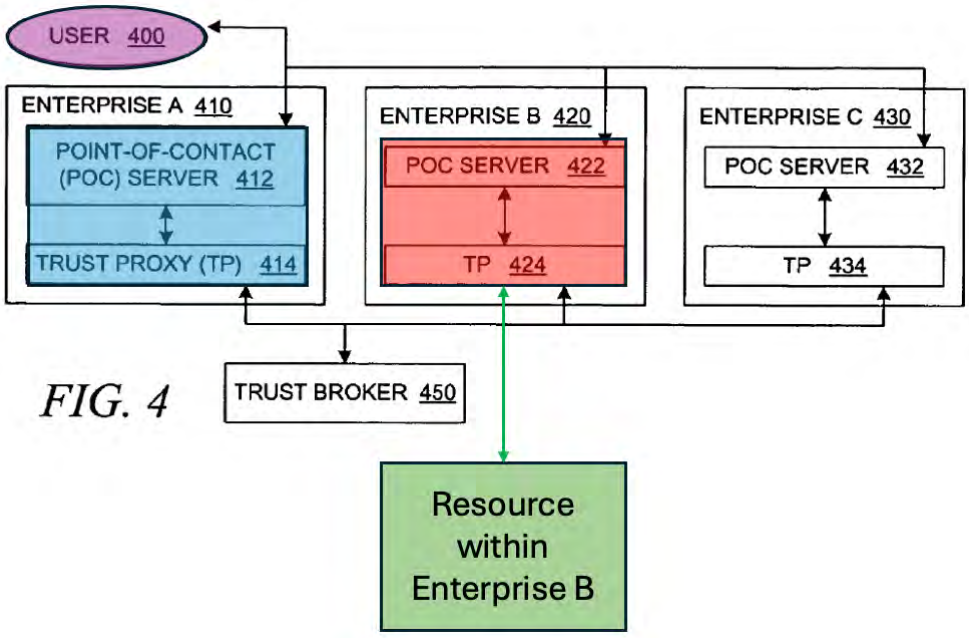


FIG. 4

C. Claim 2: "The method of claim 1 further comprising, making, by the machine, a target service available to interactions between the principal and an external service, the target service is directly accessible from an environment of the identity service."

96. As I explained for Claim [1C] and [1D], Hinton discloses, and it would have been obvious, that the POC/TP of Enterprise A assists in authenticating the user with the POC/TP of Enterprise B, which manages access to various services, including external ones. It is therefore my opinion that Hinton teaches that the POC/TP of Enterprise A enables the user to access a target service, permitting interaction with an external service, where the target service is directly provided by Enterprise B.

D. Claim 3: "The method of claim 1, wherein supplying further includes redirecting the principal to the identity service and including with the redirection the new authentication request and the new authentication response represented by the authentication message, and the identity service authenticates the principal automatically in response to the new authentication response included with the authentication message."

97. As I explained for Claim [1C] and [1G], Hinton discloses that the Enterprise A POC/TP provides an authentication message in the form of a single-sign-on token containing both a new authentication request and a new authentication response, which automatically authenticates the user with the Enterprise B POC/TP. Hinton also explains that this token "may be sent using HTTP redirection via the user's browser." Ex. 1004 at ¶ 156. It is my opinion that a POSITA would have understood that HTTP redirection entails redirecting the user to the Enterprise B POC/TP.

E. Claim 4: "The method of claim 3, wherein supplying further includes representing the new authentication response as a first authentication token that informs the identity service that the principal is currently already properly authenticated to the processing associated with the method."

98. As I explained for [1C] and [1G], Hinton explains that the Enterprise A POC/TP provides an authentication message containing both a new authentication request and a "single-sign-on token," which informs the Enterprise B POC/TP that the user has already been authenticated to access the requested resource.

F. Claim 5: "The method of claim 4, wherein supplying further includes adding a second authentication to a second redirection of the principal, wherein the second authentication represents authentication of the principal to the identity service and wherein the second redirection directs the principal to request a target service that is to be proxied on behalf of the principal from the identity service."

99. As I explained for claim 3, Hinton discloses an initial redirection initiated through an HTTP request from the user. Following this redirection, Hinton explains that the number of authentication interactions required by Enterprise B depends on the type of token received from domain 410. Ex. 1004 at ¶ 158. Hinton discloses: "For example, domain **[410]** may provide a binary Security token containing the user's name and password to be validated against the user registry at domain **420**." *Id*. I note that there is an obvious typo in Hinton, but I have corrected it in the quote above. The original text recites domain 420 providing the token for validation against the user registry at domain 420, which does not make sense. Indeed, based upon the previous sentence which talks about domain 410 presenting a token to domain 420, a POSITA would have understood this to be a typo and I have therefore corrected it in the quote above.

100. In my opinion, it would have been obvious to a POSITA that certain domains, especially those handling sensitive information, require a second authentication challenge/response layer, such as two-factor authentication. Hinton acknowledges that additional steps may be necessary to authenticate the user within the Enterprise B domain. Ex. 1004 at ¶ ¶ 158-160. It is further my opinion

that it would also have been obvious to a POSITA that this second authentication challenge/response is handled by directing the user to a service proxied through the Enterprise B POC/TP.

G. Claim 6: "The method of claim 1, wherein supplying further includes representing the new authentication response as an instruction to the identity service to enforce its own independent authentication with the principal before considering the principal authenticated to the identity service."

101. As I explained for Claim [1G], Hinton discloses, and it would have been obvious to a POSITA, that the single-sign-on token supplied from the Enterprise A POC/TP to the Enterprise B POC/TP informs Enterprise B POC/TP that the user is already authenticated with Enterprise A.

102. Similar to what I explained for Claim [1I], Hinton discloses, and it would have been obvious to a POSITA, that Enterprise B may have its own additional, independent authentication policies to enforce, such as validating against its own user registry. Ex. 1004 at ¶ 158. Accordingly, it is my opinion that a POSITA would have understood that the single-sign-on token serves as an instruction to the Enterprise B POC/TP to apply and enforce these local authentication policies.

H. Claim 7: "The method of claim 1 further comprising, interacting, by the machine, with the principal via a World-Wide Web (WWW) browser over the Internet using at least one of a Security Assertion Markup Language (SAML), a Liberty Alliance markup language, and Web Services (WS) Foundation markup language."

103. Hinton discloses that a SAML assertion is an example of a possible assertion format that may be used within the present invention. Ex. 1004 at ¶ 64. Accordingly, it is my opinion that a POSITA would have understood that interactions between the user's web browser and the Enterprise A POC/TP can occur via SAML.

I. Claim 8:

104. In my opinion, Claim 8 is also invalid over the same prior art. I explained for claim 1 that the machine on which the method was executing was the Enterprise A POC/TP. For claim 8, the machine implementing and executing the claimed method is the Enterprise B POC/TP.

1. [8PRE]: "A machine-implemented method to execute on a machine, comprising:"

105. Whereas claim 1 is from the perspective of the Enterprise A POC/TP, claim 8 is from the perspective of the Enterprise B POC/TP, which is the machine implementing and executing the claimed method. As described by Hinton, the method may be implemented and executed on a single device. Ex. 1004 at ¶ 106.

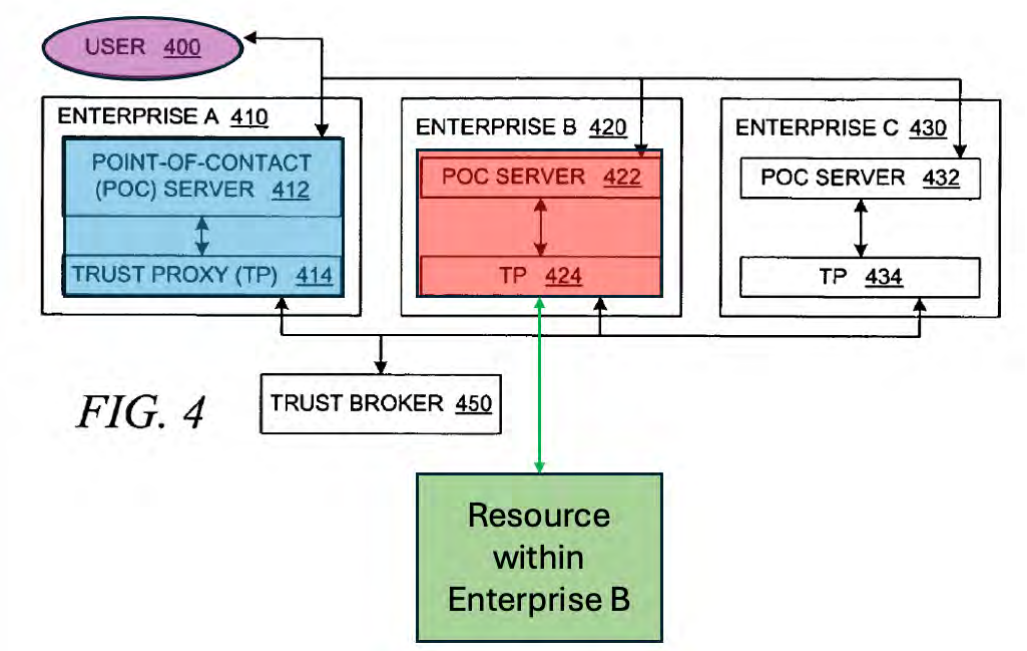


FIG. 4

2. [8A]: "receiving, by the machine, an authentication request and an authentication response as a single sign-on transaction from a principal,"

106. As I explained for [1C], Hinton discloses that the Enterprise B POC/TP receives a "federation single-sign-on token for the user." Ex. 1004 at ¶ 156. As I explained in [1D], it is my opinion that a POSITA would have understood, or it would have been obvious, that this token includes both a new authentication request and an authentication response, forming a single-sign-on transaction on behalf of the user.

3. [8B]: "the authentication request and the authentication response are received indirectly from the principal via an original identity service acting as a proxy on behalf of the principal and"

107. Hinton discloses that the single-sign-on token "may be sent [from Enterprise A POC/TP] by invoking the request directly of" Enterprise B POC/TP.

Ex. 1004 at ¶ 156. In my opinion, a POSITA would have understood that this means the authentication request and authentication response are received indirectly from the user via Enterprise A POC/TP (the original identity service), which acts as a proxy on behalf of the principal.

4. [8C]: "actions of that original identity service are transparent to the principal and"

108. Hinton discloses that, when the user requests a protected resource in the relying domain (Enterprise B), the issuing domain's (Enterprise A's) POC server "actively intercept[s]" the request. Ex. 1004 at ¶ 139. In my opinion, a POSITA would have understood that this interception means the actions of Enterprise A POC/TP are transparent to the user.

5. [8D]: "the authentication response produced by that original identity service to authenticate the principal for the single sign-on transaction,"

109. As I explained for [1D], the Enterprise A POC/TP produces a single-sign-on token that authenticates the user with Enterprise B as part of a single-sign-on transaction.

6. [8E]: "the authentication request and the authentication response produced by the original identity service are different from that which was originally provided by the principal to the original identity service and"

110. As I explained for [1D], the "federation single-sign-on token" sent by the Enterprise A POC/TP to the Enterprise B POC/TP includes both a new authentication request and a new authentication response. In my opinion, a

POSITA would have understood that this user's request must necessarily differ from the user's initial authentication request, since it needs to identify the user making the request when the request originates from the Enterprise A POC rather than directly from the user. Furthermore, a POSITA would have understood that the "federation single-sign-on token" (serving as the authentication response) is generated by the Enterprise A POC/TP and thus differs from the original credentials or information initially provided by the user to Enterprise A.

7. [8F]: "the authentication request and the authentication response are made on behalf of the principal once the principal is authenticated by the original identity service;"

111. As I explained for [1B], Hinton discloses, and it would have been obvious to a POSITA, that the user is first authenticated with the Enterprise A POC/TP prior to the generation and transmission of the single-sign-on token to Enterprise B.

8. [8G]: "detecting, by a machine and from an identity service, an instruction, which is represented in the authentication response,"

112. As I explained for claim 6, Hinton discloses, and it would have been obvious to a POSITA, that the Enterprise B POC/TP (identity service) detects the

receipt of the single-sign-on token, which functions as an instruction to the Enterprise B POC/TP.

9. [8H]: "the identity service is different from the original identity service, and the identity service and the original identity service are in a secure relationship with one another; and"

113. Hinton discloses the use of multiple identity services, including the Enterprise A POC/TP (the original identity service) and the Enterprise B POC/TP (a different identity service, corresponding to the claimed "identity service [] different from the original identity service"). These two identity services are distinct from one another, as illustrated below.

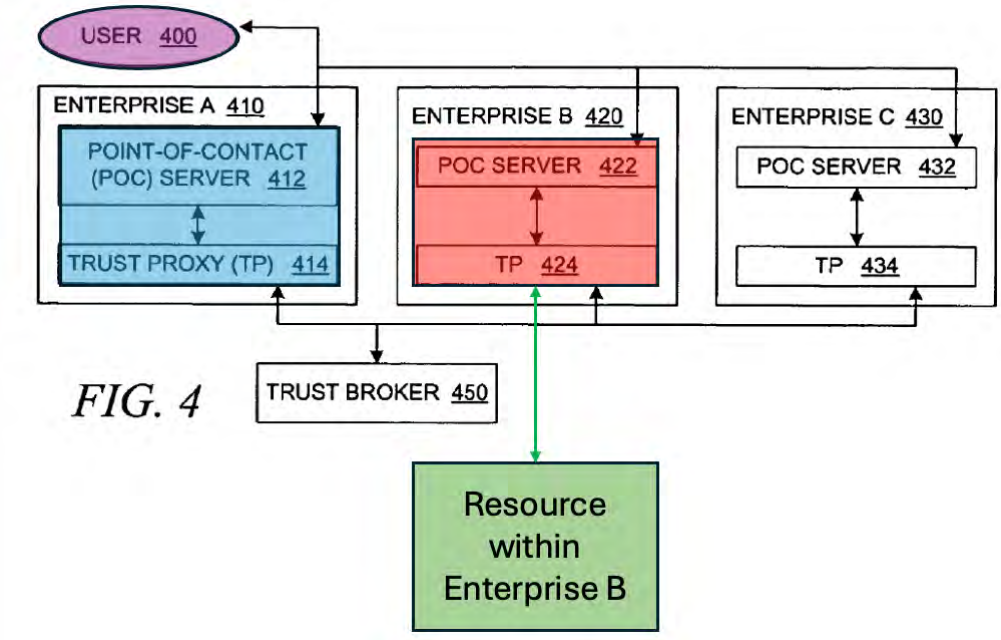


FIG. 4

114. Hinton further discloses that the Enterprise A POC/TP and the Enterprise B POC/TP maintain a secure relationship with one another, which can

be verified through the trust broker **450**. As described, the trust broker "is used to establish, on behalf of a federation participant, a trust relationship based on transitive trust with other federation partners." Ex. 1004 at ¶ 125.

10. [8I]: "taking, by the machine, an action in response to the instruction to authenticate the principal for access to targeted services,"

115. As I explained for [8G], Hinton discloses that upon detecting receipt of the single-sign-on token, the Enterprise B POC/TP "validates the token, and assuming the token is valid and trusted, generates a locally valid token for the user." Ex. 1004 at ¶ 157. In my opinion, a POSITA would have understood these steps as actions taken in response to the instruction—conveyed by the single-sign-on token—to authenticate the user.

11. [8J]: "access to the target services occur via proxied sessions through the identity service and transparent to the principal,"

116. As I explained for [1F], access to the user's requested services occurs through the Enterprise B POC/TP (identity service) in a manner that is transparent to the user.

12. [8K]: "wherein the action taken is dynamic and a real-time evaluation of policies processed by the identity service."

117. As I explained for [8I], the actions taken are to validate the user by determining whether the token is valid, trusted, and whether the user is authorized. In my opinion, this validation must occur dynamically and in real time, at least

because it would not be acceptable from a user experience or security standpoint for such a process to be delayed or evaluated non-real-time.

J. Claim 9: "The method of claim 8, wherein detecting further includes identifying the instruction as an assertion from the identity service that the principal is currently already authenticated to the identity service."

118. As I explained for [8G], Hinton discloses, and it would have been obvious to a POSITA, that the Enterprise B POC/TP detects the receipt of the single-sign-on token, which functions as an instruction to the Enterprise B POC/TP. In my opinion, a POSITA would have further understood that the single-sign-on token serves as an assertion from the Enterprise A POC/TP that the user has already been authenticated within the Enterprise A domain.

K. Claim 10: "The method of claim 9, wherein taking further includes authenticating the principal, in response to the assertion, and supplying an authentication token to the principal indicating that the principal is authenticated for access to the targeted services."

119. As I explained for [8J], Enterprise B POC/TP takes action by "validat[ing] the token, and assuming the token is valid and trusted, generat[ing] a locally valid token for the user." Ex. 1004 at ¶ 157. In my opinion, a POSITA would have understood that this locally valid token indicates the user has been authenticated to access the requested services within the Enterprise B domain, and that the token would then need to be supplied to the principal. Furthermore, it is my opinion that it would have been obvious to a POSITA to supply the locally

valid token to the user so that the user could utilize it to access services within the domain.

L. Claim 11: "The method of claim 8, wherein detecting further includes identifying the instruction as an identity service request from the identity service to independently authenticate the principal."

120. As I explained for [8G], Hinton discloses—and it would have been obvious to a POSITA—that the Enterprise B POC/TP detects the receipt of the single-sign-on token, which serves as an instruction to initiate the authentication process. Hinton explains that "domain [410] may provide a binary Security token containing the user's name and password to be validated against the user registry at domain 420." Ex. 1004 at ¶ 158. Accordingly, Hinton discloses that domain 420 (Enterprise B) independently authenticates the user by validating the credentials against its own user registry.

M. Claim 12: "The method of claim 11, wherein taking further includes interactively authenticating the principal via a challenge and response dialogue in response to the identity service request and supplying an authentication token to the principal that indicates the principal is authenticated for access to the targeted services, if authentication is successful."

121. Hinton teaches that the number of interactions required for Enterprise B to authenticate the user "[d]epend[] on the type of token presented by domain 410." Ex. 1004 at ¶ 158. For example, Hinton explains that domain 410 may provide a binary security token that includes the user's name and password, which

can then be validated against the user registry maintained by domain 420 (Enterprise B). *Id*.

122. In my opinion, it would have been further obvious to a POSITA that certain domains, particularly those handling sensitive information, require an additional challenge-response layer, such as two-factor authentication. Indeed, Hinton acknowledges that additional steps may be necessary to authenticate the user within the Enterprise B domain. Ex. 1004 at ¶ ¶ 158-160. It is my opinion that it would have been obvious that the Enterprise B POC/TP can directly send this challenge to the user and will only proceed to authenticate the user by issuing the authentication token if the user successfully completes the additional authentication step.

N. Claim 13:

1. [13PRE]: "The method of claim 8 further comprising:"

123. I incorporate my analysis for claim 8 herein.

2. [13A]: "receiving, by the machine, an authentication service token from the identity service or an external service associated with the principal, the authentication service token indicates the principal has been authenticated for access to the targeted services, and the targeted services are external to the identity service; and"

124. As I explained for [8G], Hinton discloses that the Enterprise B POC/TP (i.e., the machine in this claim limitation) "validates the token, and assuming the token is valid and trusted, generates a locally valid token for the

user." Ex. 1004 at ¶ 157. In my opinion, a POSITA would have understood that the Enterprise B POC/TP thereby receives the locally valid token from the identity service, which signifies that the user is authenticated to access the services available through the Enterprise B POC/TP.

125. As I explained for [1H], Enterprise B POC/TP may authenticate users for access to services external to the Enterprise B domain.

3. [13B]: "using, by the machine, the authentication service token to proxy the targeted services to the identity service or the external service associated with the principal transparent to the principal, access sessions between the principal and the target services are proxied via the identity service or the external service."

126. As I explained for [8J], access to the user's requested services is proxied through Enterprise B POC/TP (identity service) transparently to the user. In my opinion, a POSITA would have understood that this proxied access utilizes the locally valid token that I discussed in 13[a]. Furthermore, it is my opinion that it would have been obvious to a POSITA that the proxied access relies on the locally valid token because the proxied access must be authenticated, and the token is necessary for that authentication.

VIII. GROUND 3 – CLAIMS 1-13 ARE RENDERED OBVIOUS BY HINTON OVER BURCH

A. Overview of Burch

127. Burch discloses a multi-factor authentication system applicable to legacy services. Ex. 1005 at Abstract. Burch recognizes the need for "enhanced

and improved security techniques" in applications handling sensitive information, such as "on-line banking." *Id.* at ¶ 4. To address this need, Burch proposes a solution for adding enhanced security to legacy systems. Figure 4 depicts one such proposed solution, which is depicted below.

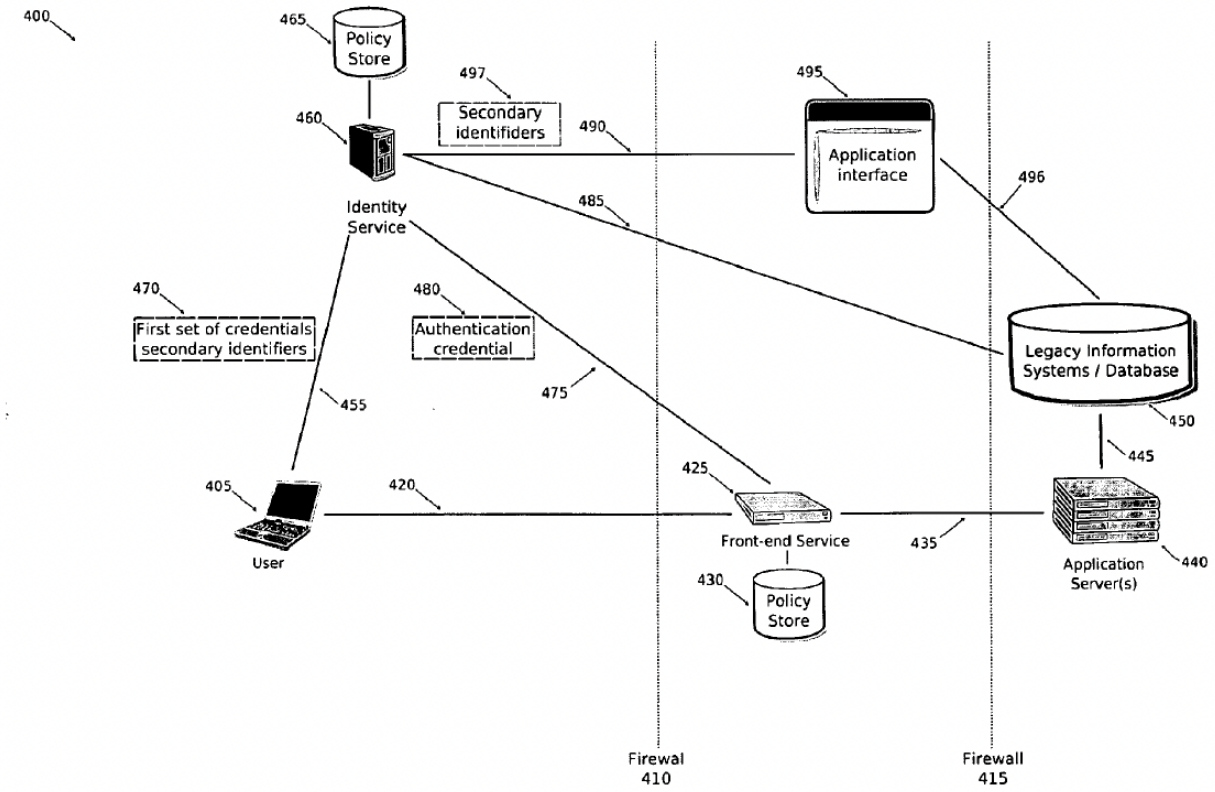


Figure 4

128. According to Burch, when a user **405** attempts to access an application hosted on server **440**, the user may first be redirected to an identity service **460** for authentication. *Id.* at ¶ ¶ 91–93. Burch explains that authentication is performed according to the policy defined at the authentication service **460**. Specifically, the policy information **465** may specify a primary set of credentials

470 as well as one or more secondary identifiers **497** that the user **405** must provide to authenticate their identity. Additionally, the policy information **465** may indicate how these secondary identifiers **497** can be obtained. *Id.* at ¶ 94. In other words, the user may be required to present multiple identifiers to successfully authenticate, thereby implementing multifactor authentication.

B. Motivation to combine Hinton and Burch

129. Hinton discloses a federated single-sign-on system whereby a user authenticates in one domain, and that authentication is then utilized to authenticate the user in another trusted domain. Ex. 1004 at ¶ ¶ 155–157.

130. From this disclosure, it is my opinion that a POSITA would have understood that different domains may enforce distinct authentication policies. In my opinion, this understanding aligns with a POSITA's general knowledge and is further supported by other references in the field. For instance, Burch notes that "enhanced and improved security techniques" are necessary for applications handling sensitive data such as "on-line banking." Ex. 1005 at ¶ 4. Additionally, Hinton acknowledges that the manner in which Enterprise B authenticates the user "[d]epend[s] on the type of token presented by domain 410." Ex. 1004 at ¶ 158. Specifically, "domain [410] may provide a binary Security token containing the user's name and password to be validated against the user registry at domain 420." *Id*.

131. Based on this understanding, it is my opinion that a POSITA would have recognized the necessity for enhanced security measures in certain situations. Such a person would also have appreciated that Hinton's system could accommodate alternative forms of authentication. For example, Burch illustrates another type of authentication that could be integrated within Hinton's framework. In my opinion, a POSITA would have been motivated to incorporate the multifactor authentication techniques described by Burch to strengthen the authentication process in Hinton.

132. In this context, in my opinion, it would have been obvious to a POSITA that, by incorporating multi-factor authentication into Hinton's federated system, the Enterprise B POC/TP could continue to receive the username and password within the security token from Enterprise A, while still requiring an additional secondary identifier from the user as described by Burch. Ex. 1005 at ¶ 94.

133. In my opinion, a POSITA would have appreciated the advantage of enhancing Hinton's authentication process with the multi-factor authentication techniques described in Burch, given that Burch highlights the increased security such measures offer for certain sensitive applications. Ex. 1005 at ¶ 4. Moreover, the benefits of single sign-on as taught by Hinton would remain intact, since the user would not be required to re-enter her username and password but would only

need to provide the secondary identifier specific to Enterprise B. Ex. 1004 at ¶ 11.

134. In my opinion, it would have also been apparent to a POSITA to combine the teachings of Hinton and Burch, as both references address related aspects within the broader domain of user authentication. Ex. 1004 at ¶ 74; Ex. 1005 at ¶ 11

135. In my opinion, a POSITA would have had a reasonable expectation of success in incorporating multifactor authentication into the federated system of Hinton, as Burch explicitly teaches adding multifactor authentication to legacy systems. It is further my opinion that it would have been obvious to a POSITA that such an addition could be implemented using well-established programming techniques. Ex. 1005 at ¶ 5. Moreover, Hinton acknowledges that the POC/TP of Enterprise B may maintain its own authentication database and procedures. Ex. 1004 at ¶ ¶ 158-160. Accordingly, in my opinion, a POSITA would have reasonably expected success in integrating the multifactor authentication approach of Burch into Enterprise B's POC/TP.

C. Claim 1:

136. My analysis for claim 1 from Grounds 1-2 applies to the combination of Hinton and Burch, and I incorporate it herein by reference. I expand upon the analysis for limitation [1I] below based upon the combination of Hinton and Burch

1. [1I]: "and a determination as to whether to use a single interaction or multiple interactions for authentication of the principal to the other services is automatically communicated in the new authentication response."

137. The same reasoning I set forth in Grounds 1 and 2 is equally applicable here. However, if the Patent Owner contends that this limitation involves the identity service (Enterprise B POC/TP in Hinton) deciding whether or not to implement multifactor authentication, this limitation is rendered obvious by the combination of Hinton and Burch. As previously noted, Burch discloses employing multifactor authentication based on the authentication policy requirements of a given domain. Ex. 1005 at ¶ 94. Moreover, a POSITA would have been motivated to apply this multifactor authentication method to Enterprise B POC/TP for the reasons discussed above.

138. Accordingly, the new authentication response sent to Enterprise B POC/TP must convey whether a single interaction or multiple interactions are necessary. Specifically, if the message includes only one authentication response but Enterprise B POC/TP's policies require multi-factor authentication, the POC/TP will recognize the need for additional interactions with the principal. This determination by Enterprise B's POC/TP is based on the data contained within the new authentication response.

D. Claim 5: "The method of claim 4, wherein supplying further includes adding a second authentication to a second redirection of the principal, wherein the second authentication represents authentication of the principal to the identity service and wherein the second redirection directs the principal to request a target service that is to be proxied on behalf of the principal from the identity service."

139. As I explained for claim 3 from Grounds 1-2, Hinton discloses an initial redirection through the user's browser, as shown in Ex. 1004 at ¶ 156, which states the token "may be sent using HTTP redirection via the user's browser" to Enterprise B POC/TP. The combination of Hinton with Burch makes a subsequent authentication via a second redirection obvious. Burch teaches that implementing multifactor authentication can involve redirecting the authentication request to a separate identity service **460**. In my opinion, a POSITA would have been motivated to incorporate this second redirection for multifactor authentication based on the rationale set forth in the motivation to combine Hinton and Burch. Additionally, Burch explains that this redirection technique enables multifactor authentication to be applied to legacy systems, meaning that Enterprise B POC/TP would not require modification to support multifactor authentication.

140. In my opinion, a POSITA would have found it obvious that the second redirection to a separate identity service, as described in Burch, would direct the user to request the target service—the service the user intends to access—and that the multifactor authentication disclosed by Burch is necessary to

gain access to that service, effectively making the redirection a request to access the service. Moreover, consistent with what I explained in [1E], Enterprise B POC/TP serves as a proxy on the user's behalf for the target service.

E. Claim 12: "The method of claim 11, wherein taking further includes interactively authenticating the principal via a challenge and response dialogue in response to the identity service request and supplying an authentication token to the principal that indicates the principal is authenticated for access to the targeted services, if authentication is successful."

141. Burch discloses the use of multifactor authentication for the Enterprise B POC/TP. In my opinion, a POSITA would have recognized that implementing this approach necessitates an additional challenge and response interaction to authenticate the user, as this is the standard method for performing authentication. Ex. 1005 at ¶ 94. In fact, Hinton also teaches that "typical user authentication" includes an "authentication challenge" followed by an "authentication response." Ex. 1004 at Fig. 1C, ¶¶ 46-47.

142. As I explained in claim 10 from Grounds 1-2, Hinton either discloses or it would have been obvious that an authentication token is provided to the user. In my opinion, it would have been apparent to a POSITA that this authentication token would only be issued to the user upon successful completion of the additional challenge/response interaction, as that dialogue serves precisely to verify the user's identity.

F. Claims 2-4, 6-11, 13

143. In my opinion, Claims 2-4, 6-11, and 13 are rendered obvious by Hinton over Burch for the reasons I explained in Grounds 1 and 2.

IX. CONCLUSION

144. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

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 this 7th day of October, 2025, in San Francisco, California.

Respectfully submitted,

Dr. Kevin Almeroth

Appendix A

Kevin C. Almeroth

Professor Emeritus
Department of Computer Science
University of California
Santa Barbara, CA 93106-5110
(805)636-1123 (office)
(805)893-8553 (fax)
almeroth@cs.ucsb.edu (email)
http://www.cs.ucsb.edu/~almeroth (WWW URL)

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

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 Wireles 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," International

Journal of Communication Networks and Distributed Systems, vol. 5, num. 1/2, pp. 109-129, July 2010.

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*

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. Rimac, 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. Krugel, "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. Suwannatat, 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 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," Assocation 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.

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 Challange*, 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.

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. Milojicic, 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)*,

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 the well-known 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. Working

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.

- "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," Networld+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), Networld+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 Technical Meeting

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. Flanagin 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

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 Challange: 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
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 Internation 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: 1995-1997

ACM Multimedia technical staff: 1994

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

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 Certain IP Camera Systems including Video Doorbells and Components Thereof (US ITC Inv. No. 337-TA-1242) [SkyBell Technologies, Inc., SB IP Holdings, LLC, and Eyetalk365, LLC v. SimpliSafe, Inc., Arlo Technologies, Inc., and Vivint Smart Home, Inc.]. 02/2021-09/2021.
- A deposition in Warner Records, Inc. et al. v. Charter Communications, Inc. (19-cv-00874-RBJ-MEH, D. Colo.). 11/2019-10/2021.
- A deposition and trial testimony in VideoShare, LLC v. Google LLC (6:19-cv-00663-ADA, W. D. Tex.). 06/2021-11/2021.
- A deposition in The Chamberlain Group, LLC v. Overhead Door Corp. (2:21-cv-0084, E. D. Tex.). 11/2021-12/2021.
- A deposition in Chewy, Inc. v. International Business Machines Corporation (1:21-cv-1319-JSR, S. D. N. Y.). 04/2021-02/2022.
- A deposition in Flexiworld Technologies, Inc. v. Roku, Inc. (6:20-cv-00819-ADA, W. D. Tex.). 10/2021-02/2022.
- A deposition in Proven Networks, LLC v. NetApp, Inc. (6:20-cv-00369-ADA, W. D. Tex.). 08/2020-03/2022.
- Trial testimony in Two Way Media LTD v. Telefonica (517/2017-X, Barcelona, Spain). 12/2015-05/2022.
- A deposition and claim construction hearing testimony in Peloton Interactive, Inc. v. Icon Health and Fitness, Inc. (1:20-cv-00662-RGA, D. Del.). 10/2020-05/2022.
- Depositions in Icon Health and Fitness, Inc. v. Peloton Interactive, Inc. (20-1386-RGA, D. Del.). 10/2020-05/2022.
- A deposition and hearing testimony in UMG Recordings, Inc., et al. v. Bright House Networks, LLC (8:19-cv-00710-MSS-TGW, M. D. Fla.). 11/2019-05/2022.
- 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. Oxylabs, 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.
- 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 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.

- Depositions in Contour IP Holding, LLC v. GoPro, Inc. (17-cv-04738-WHO, N. D. Cal.). 10/2019-present.
- 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 Marble VOIP Partners LLC v. Zoom Video Communications, Inc. 4:23-cv-03619-JSW, N. D. Cal.). 12/2023-present.
- Depositions in Western Digital Technologies, Inc. v. Viasat, Inc. (4:22-cv-4376-HSG, N. D. Cal.). 08/2022-present.
- A deposition in Robocast, Inc. v. Netflix, Inc. (1:22-cv-00305-RGA, D. Del.). 07/2022-present.
- A deposition in Time Warner Cable Enterprises, LLC v. Nokia of America Corp. (650748/2022, 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 SmartSky Networks, LLC v. Gogo Business Aviation, LLC (22-266-VAC, D. Del.). 12/2023-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.
- Depositions in BARCO, Inc. v. YeaLink Network Technology Co., LTD (2:23-cv-00521-JRG-RSP, E. D. Tex.). 06/2024-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), and 11,738,659 (IPR2024-001167) [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 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-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 Beijing Meishe Network Technology Co. LTD. v. TikTok, Inc. (5:23-cv-6012-SI, N. D. Cal.). 05/2023-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 and trial testimony in Express Mobile, Inc. v. GoDaddy.com, LLC (1:19-cv-01937-RGA, D. Del.). 05/2020-present.