



US006226686B1

(12) **United States Patent**
Rothschild et al.

(10) **Patent No.:** **US 6,226,686 B1**
(45) **Date of Patent:** **May 1, 2001**

(54) **SERVER-GROUP MESSAGING SYSTEM FOR INTERACTIVE APPLICATIONS**

OTHER PUBLICATIONS

(75) Inventors: **Jeffrey Jackiel Rothschild**, Los Gatos;
Daniel Joseph Samuel, Sunnyvale;
Marc Peter Kwiatkowski, Los Gatos,
all of CA (US)

Ahuja, S.R., et al., "The Rapport Multimedia Conferencing System," Conference on Office Information Systems 1988, pp. 1-7.

(List continued on next page.)

(73) Assignee: **HearMe**, Mountain View, CA (US)

Primary Examiner—Zarni Maung

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(74) *Attorney, Agent, or Firm*—Sterne, Kessler, Goldstein, & Fox PLLC

(57) **ABSTRACT**

(21) Appl. No.: **09/407,371**

(22) Filed: **Sep. 28, 1999**

A method for deploying interactive applications over a network containing host computers and group messaging servers is disclosed. The method operates in a conventional unicast network architecture comprised of conventional network links and unicast gateways and routers. The hosts send messages containing destination group addresses by unicast to the group messaging servers. The group addresses select message groups maintained by the group messaging servers. For each message group, the group messaging servers also maintain a list of all of the hosts that are members of the particular group. In its most simple implementation, the method consists of the group server receiving a message from a host containing a destination group address. Using the group address, the group messaging server then selects a message group which lists all of the host members of the group which are the targets of messages to the group. The group messaging server then forwards the message to each of the target hosts. In an interactive application, many messages will be arriving at the group server close to one another in time. Rather than simply forward each message to its targeted hosts, the group messaging server aggregates the contents of each of messages received during a specified time period and then sends an aggregated message to the targeted hosts. The time period can be defined in a number of ways. This method reduces the message traffic between hosts in a networked interactive application and contributes to reducing the latency in the communications between the hosts.

Related U.S. Application Data

(63) Continuation of application No. 08/896,797, filed on Jul. 18, 1997, now Pat. No. 6,018,766, which is a continuation of application No. 08/595,323, filed on Feb. 1, 1996, now Pat. No. 5,822,523.

(51) **Int. Cl.**⁷ **G06F 15/16**

(52) **U.S. Cl.** **709/245; 709/218**

(58) **Field of Search** 709/218, 206,
709/230, 236, 207, 231, 232, 204, 245;
370/389, 390

(56) **References Cited**

U.S. PATENT DOCUMENTS

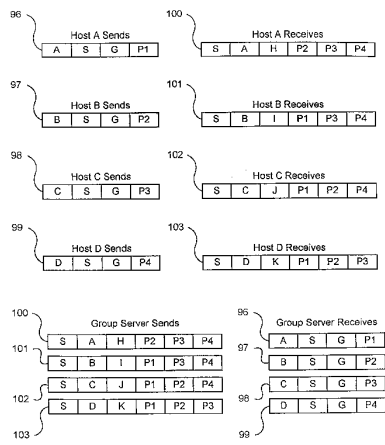
4,470,954 9/1984 Cotton et al. 370/60
4,572,509 2/1986 Sitrick 273/85 G
4,740,954 4/1988 Cotton et al. 370/60
4,807,224 2/1989 Naron et al. 370/94

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

0 637 149 2/1995 (EP) H04L/12/18
WO 93/15572 8/1993 (WO) H04J/3/26
WO 95/10908 4/1995 (WO) H04L/12/18
WO 95/10911 4/1995 (WO) H04L/29/06

19 Claims, 11 Drawing Sheets



U.S. PATENT DOCUMENTS

4,984,235	1/1991	Hillis et al.	370/60
4,991,171	2/1991	Teraslinna et al.	370/94.1
4,998,199	3/1991	Tashiro et al.	364/410
5,079,767	1/1992	Perlman	370/94.3
5,083,800	1/1992	Lockton	273/439
5,089,813	2/1992	DeLuca et al.	340/825.44
5,117,420	5/1992	Hillis et al.	370/60
5,150,410	9/1992	Bertrand	380/28
5,150,464	9/1992	Sidhu et al.	395/200.01
5,245,608	9/1993	Deaton, Jr. et al.	370/94.1
5,257,113	10/1993	Chen et al.	358/426
5,287,530	2/1994	Davis et al.	370/94.1
5,289,460	2/1994	Drake, Jr. et al.	370/17
5,297,143	3/1994	Fridrich et al.	370/85.3
5,309,433	5/1994	Cidon et al.	370/60
5,309,437	5/1994	Perlman et al.	370/85.13
5,329,619	7/1994	Page et al.	395/200.01
5,361,256	11/1994	Doeringer et al.	370/60
5,365,523	11/1994	Derby et al.	370/85.2
5,408,261	4/1995	Kamata et al.	348/15
5,418,912	5/1995	Christenson	395/200
5,430,727	7/1995	Callon	370/85.13
5,453,780	9/1995	Chen et al.	348/15
5,475,819	12/1995	Miller et al.	395/200.01
5,481,735	1/1996	Mortensen et al.	395/200.1
5,502,726	3/1996	Fischer	370/94.1
5,517,494	5/1996	Green	370/60
5,558,339	9/1996	Perlman	463/42
5,581,552	12/1996	Civanlar et al.	370/396
5,586,257	12/1996	Perlman	463/42
5,586,937	12/1996	Menashe	463/41
5,590,281	12/1996	Stevens	395/200.01
5,594,732	1/1997	Bell et al.	370/401
5,630,757	5/1997	Gagin et al.	463/43
5,634,011	5/1997	Auerbach et al.	395/200.15
5,674,127	10/1997	Horstmann et al.	463/42
5,685,775	11/1997	Bakoglu et al.	463/41
5,729,540	3/1998	Wegrzyn	370/336
5,740,170	4/1998	Andou et al.	370/390
5,740,231	4/1998	Cohn et al.	379/83
5,761,436	6/1998	Nielsen	395/200.75
5,778,187	7/1998	Monteiro et al.	395/200.61
5,784,568	6/1998	Needham	395/200.64
5,805,830	9/1998	Reese et al.	395/200.35
5,812,552	9/1998	Arora et al.	370/401
5,930,259	7/1999	Katsube et al.	370/409
5,946,308	8/1999	Dobbins et al.	370/392
5,956,485	9/1999	Perlman	395/200.34

OTHER PUBLICATIONS

Armstrong, S. et al., "Multicast Transport Protocol," Network Working Group Request For Comments: 1301, 1992, 31 pages.

Berglund, E.J. and Cheriton, D.R. "Amaze: A Distributed Multi-Player Game Program using the Distributed V Kernel," IEEE Proceedings of the Fourth Int'l Conf. on Distributed Systems, 1984, pp. 248-253.

Braden, R. (ed.), "Requirements for Internet Hosts—Communication Layers," Network Working Group Request for Comments: 1122, Oct. 1989, 100 pages.

Braden, R. (ed.), "Requirements for Internet Hosts—Application and Support," Network Working Group Request for Comments: 1123, Oct. 1989, 84 pages.

Braden, R. et al., "Integrated Services in the Internet Architecture: An Overview," Network Working Group Request for Comments: 1633, Jun. 1994, 27 pages.

Braudes, R. and Zabele, S., "Requirements for Multicast Protocols," Network Working Group Request for Comments: 1458, May 1993, 16 pages.

Cameron, P. et al., "Transport Multiplexing Protocol (TMux)," Network Working Group Request for Comments: 1692, Aug. 1994, 10 pages.

Cheriton, D.R. and Deering, S.E., "Host Groups: A Multicast Extension for Datagram Internetworks," ACM/IEEE Proceedings of the Ninth Data Communications Symposium, Sep. 10-13, 1985, pp. 172-179.

Chimiak, W., "A Comment on Packet Video Remote Conferencing and the Transport/Network Layers," Network Working Group Request for Comments: 1453, Apr. 1993, 9 pages.

Crocker, D.H., "Standard For The Format Of ARPA Internet Text Messages," IETF RFC #822, Aug. 13, 1982, 43 pages.

Deering, S.E. and Cheriton, D.R., "Host Groups: A Multicast Extension to the Internet Protocol," Network Working Group Request for Comments: 966, Dec. 1985, 23 pages.

Deering, S., "Host Extensions for IP Multicasting," Network Working Group for Comments: 1054, May 1988, 16 pages.

Deering, S., "Host Extensions for IP Multicasting," Network Working Group Request for Comments: 1112, Aug., 1989, 14 pages.

Handley, M.J., "The Car System: Multimedia in Support of Collaborative Design," Computing and Control Division Colloquium on 'Multimedia and Professional Applications', Feb. 3, 1993, pp. 8/1-8/5.

Henckel, L., "Multipeer Transport Services for Multimedia Applications," High Performance Networking, V: Proc. Of the IFIP TC6/WG6.4 Fifth International Conference on High Performance Networking, Jun. 27-Jul. 1, 1994, pp. 167-184.

Kirsche, T. et al., "Communication support for cooperative work," *Computer Communications*, vol. 16, No. 9, Sep. 1993, pp. 594-602.

Lauwers, J.C. et al., "Replicated Architectures for Shared Window Systems: A Critique," Proc. of the ACM Conference on Office Information Systems, 1990, pp. 249-260.

Leung, Y-W. And Yum, T-S., "Optimum Connection Paths for a Class of Videoconferences," Int'l Conference on Comm. ICC 91, vol. 1 of 3, Jun. 23-26, 1991, pp. 0859-0865.

Leung, Y-W. And Yum, T-S., "A Modular Multirate Video Distributing System—Design and Dimensioning," IEEE/ACM Transactions on Networking, vol. 2, No. 6, Dec. 1994, pp. 549-557.

Li, Y. and Andresen, S., "Multipoint Conferencing for Mobile Communications Network," 2nd Int'l. Conference on Universal Personal Communications, Oct. 12-15, 1993, pp. 212-216.

Multipoint Control Units For Audiovisual Systems Using Digital Channels Up To 2 Mbit/s, ITU Standard Draft H.231, 1993, pp. 11-22.

Ngoh, L., "Multicast Support for Group Communications," *Computer Networks and ISDN Systems*, 166-178, Oct. 1991, pp. 166-178.

Postel, J.B., "Simple Mail Transfer Protocol," Internet Engineering Task Force (IETF) Request for Comments (RFC) 821, Aug. 1982, 59 pages.

Rajagopalan, B., "Membership protocols for distributed conference control," *Computer Communications*, vol. 18, No. 10, Oct. 1995, pp. 695-708.

- Ramanathan, S. et al., "Optimal Communication Architecture for Multimedia Conferencing in Distributed Systems," The 12th Int'l Conference on Distributed Computing Systems, Jun. 9–12, 1992, pp. 46–53.
- Rose, M.T. and Stefferud, E.A., "Proposed Standard for Message Encapsulation," Network Working Group Request for Comments: 934, Jan. 1985, 9 pages.
- Schaffer, U., "MPPS—A Multiparty Presentation Service," Upper Layer Protocols, Architectures and Applications: Proc. Of the IFIP TC6/WG6.5 International Conference on Upper Layer Protocols, Architectures and Applications, Jun. 1–3, 1994, pp. 243–256.
- Schooler, E.M., "The Impact of Scaling on a Multimedia Connection Architecture," *ACM Journal of Multimedia Systems*, vol. 1, No. 1, 1993, pp. 1–10.
- Schulzrinne, H., "RTP: A Transport Protocol for Real-Time Applications," IETF Internet Draft draft-ietf-avt-rtp-00.doc, Dec. 15, 1992, 23 pages.
- Schulzrinne, H. and Casner, S., "RTP: A Transport Protocol for Real-Time Applications," IETF Internet Draft draft-ietf-avt-rtp-01.txt, May 6, 1993, 16 pages.
- Schulzrinne, H. and Casner, S., "RTP: A Transport Protocol for Real-Time Applications," IETF Internet Draft draft-ietf-avt-rtp-02.txt, Jul. 30, 1993, 24 pages.
- Schulzrinne, H. and Casner, S., "RTP: A Transport Protocol for Real-Time Applications," IETF Internet Draft draft-ietf-avt-rtp-04.txt, Oct. 20, 1993, 33 pages.
- Schulzrinne, H. et al., "RTP: A Transport Protocol for Real-Time Applications," Network Working Group Request for Comments Request for Comments: 1889, Jan. 1996, 61 pages.
- Singhal, S.K. and Cheriton, D.R., "Using a Position History-Based Protocol for Distributed Object Visualization," Stanford University Technical Report No. CS-TR-94-1505, 1994, 25 pages.
- "System for Establishing Communication Between Audio-visual Terminals Using Digital Channels Up To 2 Mbit/s," Amended/New Draft Recommendation Of The H.240-Series Submitted To The Xth CCITT Plenary Assembly COM XV-R 94-E, May 1992, 68 pages.
- Thomas, E., "Listserv Distribute Protocol," Network Working Group Request for Comments: 1429, Feb., 1993, 7 pages.
- Turletti, T., "H.261 software codec for videoconferencing over the Internet," *Rapports de Recherche* No. 1834, Jan. 1993, pp. 1–18.
- Vin, H.M. et al., "Multimedia Conferencing in the Etherphone Environment," *Computer: Multimedia Information Systems*, Oct. 1991, pp. 69–79.
- Vonderweidt, G. et al., "A Multipoint Communication Service for Interactive Applications," *IEEE Transactions on Communications*, vol. 39, No. 12, Dec. 1991, pp. 1875–1885.
- Waitzman, D. et al., "Distance Vector Multicast Routing Protocol," Network Working Group Request for Comments: 1075, Nov. 1988, 20 pages.
- Wancho, F., *Digest Message Format*: Network Working Group Request for Comments: 1153, Apr. 1990, 4 pages.
- Waters, A.G., "Multicast Provision for High Speed Networks," *High Performance Networking, IV: Proc. Of the IFIP TC6/WG6.4 Fourth International Conference on High Performance Networking*, Dec. 14–18, 1992, pp. 317–332.
- Weiss, G. and Ziegler, C., "Packet Switched Voice Conferencing Across Interconnected Networks," *Proceedings 13th Conference on Local Computer Networks*, Oct. 10–12, 1988, pp. 114–124.
- Weiss, G. and Ziegler, C., "A Comparative Analysis of Implementation Mechanism for Packet Voice Conferencing," *IEEE INFOCOM '90 Proceedings vol. 1*, 1990, pp. 1062–1070.
- Willebeck-LeMair, M.H. and Shae, Z-Y., "Centralized versus Distributed Schemes for Videoconferencing," *Proceedings of the Fifth IEEE Computer Society Workshop on Future Trends of Distributed Computing Systems*, Aug. 28–30, 1995, pp. 85–93.
- Zarros, P.N., et al., "Statistical Synchronization Among Participants in Real-Time Multimedia Conference," *IEEE Infocom Proceedings '94 vol. 1*, 1994, pp. 912–919.
- Ziegler, C. et al., "Implementation Mechanisms for Packet Switched Voice Conferencing," *IEEE Journal on Selected Areas in Communications*, vol. 7, No. 5, Jun. 1989, pp. 698–706.
- Altenhofen, Michael et al., "The BERKOM Multimedia Collaboration Service," *ACM Multimedia*, 1993, pp. 457–462.
- Arango, Mauricio et al., "Touring Machine: A Software Infrastructure to Support Multimedia Communications," *Communications of the ACM*, 1993, pp. 186–189.
- Chang, Wan-the et al., "Call Processing And Signaling In A Desktop Multimedia Conferencing System," *Proc. Of GLOBECOM*, 1992, pp. 225–229.
- Deering, Stephen Edward, *Multicast Routing In A Datagram Internetwork*, Stanford University Dissertation, Dec. 1991, pp. i–xiii and 1–137.
- Horton, Mark R., "UUCP Mail Interchange Format Standard," *Networking Working Group Request for Comments: 976*, Feb. 1986, 10 pages.
- Kantor, Brian and Lapsley, Phil, "Network News Transfer Protocol: A Proposed Standard for the Stream-Based Transmission of News," *Networking Working Group Request for Comments: 977*, Feb. 1986, 22 pages.
- Leiner, B. (ed.), "Critical Issues in High Bandwidth Networking," *Networking Working Group Request for Comments: 1077*, Nov. 1988, 37 pages.
- Nagle, John, "Congestion Control in IP/TCP Internetworks," *Networking Group Request for Comments: 896*, Jan. 6, 1984, 8 pages.
- Ong, Lyndon Y. and Schwartz, Mischa, "Centralized and Distributed Control for Multimedia Conferencing," *Proceedings of ICC*, 1993, pp. 197–201.
- Romahn, Götz, "System Aspects Of Multipoint Videoconferencing," *GLOBECOM*, 1987, pp. 723–725.
- Schulzrinne et al., "RTP: A Transport Protocol for Real-Time Applications," IETF Internet Draft draft-ietf-avt-rtp-06.txt, Nov. 28, 1994, 93 pages.
- Schulzrinne et al., "RTP: A Transport Protocol for Real-Time Applications," IETF Internet Draft draft-ietf-avt-rtp-new-08.txt, Jul. 14, 2000, 90 pages.
- Zellweger, Polle T. et al., "An Overview Of The Etherphone System And Its Applications," *2nd IEEE Conference on Computer Workstations*, Mar. 7–10, 1988, pp. 160–168.
- Defendants' Initial Disclosure of Prior Art Under Civil Local Rule 16–7(D)–(E), 21 Pages, Entered Apr. 4, 2000 in *HearMe v. Lipstream Networks, Inc. et al.*, United States District Court for the Northern District of California, Case No. C 99–04506 WHA.

- Defendants' Response Chart For U.S. application No. 5,822, 523 Under Civil Local Rule 16-9(B), 26 Pages Plus Exhibits A-K, Dated Jul. 5, 2000, Filed in *HearMe v. Lipstream Networks, Inc. et al.*, United States District Court for the Northern District of California—San Francisco Division, Case No. C 99-04506 WHA.
- Defendants' Response Chart For U.S. application No. 6,018, 766 Under Civil Local Rule 16-9(B), 28 Pages Plus Exhibits A-J, Dated Aug. 1, 2000, Filed in *HearMe v. Lipstream Networks, Inc. et al.*, United States District Court for the Northern District of California—San Francisco Division, Case No. C 99-04506 WHA.
- Addeo, E.J. et al., "A Multi-Media Multi-Point Communication Services Capability for Broadband Networks," 1987, pp. 423-428.
- Addeo, E.J. et al., "Personal Multi-Media Multi-Point Communication Services for Broadband Networks," 1988, pp. 53-57.
- Aguilar, Lorenzo, "Datagram Routing for Internet Multicasting," 1984, pp. 58-63.
- Aguilar, L. et al., "Architecture for a Multimedia Teleconferencing System," 1986, pp. 126-136.
- Aras, C. et al., "Real-Time Communication in Packet-Switched Networks," 1994, pp. 122-139.
- Baguette, Yves and Danthine, André, "Comparison of TP4, TCP and XTP—Part 1: Connection Management Mechanisms (*)," vol. 3-N 5, Sep.-Oct. 1992, pp. 1-12.
- Baker, Rusti et al., "Multimedia Processing Model for a Distributed Multimedia I/O System*," Network and Operating System Support for Digital Audio and Video, 1992, pp. 164-175.
- Bettati, R. et al., "Connection Establishment for Multi-Party Real-Time Communication," Network and Operating Systems Support for Digital Audio and Video, 1995, pp. 240-250.
- Bharath-Kumar, Kadaba and Jaffe, Jeffrey M., "Routing to Multiple Destinations in Computer Networks," 1993, pp. 343-351.
- Birchler, Barbara D. et al., "Toward a general Theory of Unicast-Based Multicast Communication*," pp. 237-251.
- Birman, K.P. and Joseph, T.A., "On Communication Support for Fault Tolerant Process Groups," Network Working Group Request for Comments: 992, Nov. 1986, pp. 1-16.
- Braden, Robert et al., "The Design of the RSVP Protocol," RSVP Project: Final Report, May 27, 1993-Jun. 30, 1995, pp. 1-21.
- Brown, E.F. et al., "A Continuous Presence Video Conferencing System," 1978, pp. 34.1.1-34.1.4.
- Brown, T. et al., "Packet Video for Heterogeneous Networks Using CU-SEEME," Proceedings ICIP-96, Sep. 16-19, 1996, pp. 9-12.
- Bubenik et al., "Multipoint Connection Management in High Speed Networks," 1991, pp. 59-68.
- Casner, Stephen et al., "N-Way Conferencing with Packet Video," The Third International Workshop on Packet Video, Mar. 22-23, 1990, pp. 1-6.
- Chia, L.T. et al., "An Experimental Integrated Workstation for Teleconferencing," Integrating Telecommunications and Information Technology on the Desktop, Mar. 1994, pp. 1-5.
- Clark, David D. et al., "Supporting Real-Time Applications in an Integrated Services Packet Network: Architecture and Mechanism," 1992, pp. 14-26.
- Clark, William J., "Multipoint Multimedia Conferencing," *IEEE Communications Magazine*, May 1992, pp. 44-50.
- Cohen, David M. and Heyman, Daniel P., "Performance Modeling of Video Teleconferencing in ATM Networks," *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 3, No. 6, Dec. 1993, pp. 408-420.
- Crowcroft, J. et al., "Multimedia Teleconferencing over International Packet Switched Networks. RN/90/XX," IEEE Conference on Communications Software: Communications for Distributed Applications & Systems, Apr. 18-19, 1991, pp. 23-33.
- Deering, Stephen et al., "An Architecture for Wide-Area Multicast Routing," 1994, pp. 126-135.
- Deering, Stephen E., "Multicast Routing in Internetworks and Extended LANs," SIGCOMM '88 Symposium Communications Architectures & Protocols, Aug. 16-19, 1988, pp. 55-64.
- Deering, Stephen E. and Cheriton, David R., "Multicast Routing in Datagram Internetworks and Extended LANs," *ACM Transactions on Computer Systems*, May 1990, vol. 8, No. 2, pp. 85-110.
- Dewan, Prasun and Choudhary, Rajiv, "A High-Level and Flexible Framework for Implementing Multiuser User Interfaces," *ACM Transactions on Information Systems*, Oct. 1992, vol. 10, No. 4, pp. 345-380.
- Draoli, M. et al., "Video Conferencing on a LAN/MAN Interconnected System: QoS Evaluation," Proceedings of the Fourth International Conference on Computer Communications and Networks, Sep. 20-23, 1995, pp. 170-177.
- Draoli, M. et al., "Videoconferencing on a LAN/MAN Architecture: Service Evaluation and System Dimensioning," *Communications Technology Proceedings*, 1996, vol. 2, pp. 630-633.
- Ensor, J. Robert et al., "The Rapport Multimedia Conferencing System—A Software Overview," 2nd IEEE Conference on Computer Workstations, Mar. 7-10, 1988, pp. 52-58.
- Ferrari, Domenico et al., "Network support for multimedia A discussion of the Tenet Approach," *Computer Networks and ISDN Systems*, 1994, pp. 1267-1280.
- Fliesser, R.J. et al., "Design of a Multicast ATM Packet Switch," 1993 Canadian Conference on Electrical and Computer Engineering, vol. 1, pp. 779-783.
- Han, Jefferson and Smith, Brian, "CU-SeeMe VR Immersive Desktop Teleconferencing," *ACM Multimedia*, 1996, 9 pages.
- Harju, Jarmo et al., "Quality and Performance of a Desktop Video Conferencing System in the Network of Interconnected LANs," Proceedings of the 19th Conference on Local Networks, 1994, pp. 365-371.
- Heinrichs, Bernd and Jakobs, Kai, "OSI Communication Services Supporting CSCW Applications," SIGDOC '93, 1993, pp. 107-115.
- Herzog, Shai et al., "Sharing 'Cost' of Multicast Trees: An Axiomatic Analysis," *ACM SIGCOMM '95 Conference*, Aug. 1995, pp. 1-15.
- Hopper, Andy, "Pandora—an experimental system for multimedia applications," *Operating Systems Review*, Apr. 1990, vol. 24, No. 2, pp. 19-34.
- Huang, Jau-Hsiung et al., "Design and Implementation of Multimedia Conference System on Broadcast Networks*," 18th Conference on Local Computer Networks, 1993, pp. 337-341.
- Jia, Weijia, "Implementation of a Reliable Multicast Protocol," *Software—Practices & Experiences*, Jul. 1997, pp. 813-849.

- Koerner, Eckhart, "Group Management for a Multimedia Collaboration Service," Presented at EUNICE '96 Summer School on Telecommunications Services, Sep. 23–27, 1996, pp. 1–11.
- Kohlert, Doug et al., "Implementing a Graphical Multi-user Interface Toolkit," *Software—Practice and Experience*, Sep. 1993, vol. 23, No. 9, pp. 981–999.
- Larsen, A.B. and Brown, E.F., "Continuous Presence Video Conferencing at 1.5–6Mb/sec," pp. 391–398.
- Lauwers, J. Chris and Lantz, Keith A., "Collaboration Awareness in Support of Collaboration Transparency: Requirements for the Next of Shared Window Systems," CHI '90 Proceedings, Apr. 1990, pp. 303–311.
- Leung, Wu-hon F. et al., "A Software Architecture for Workstations Supporting Multimedia Conferencing in Packet Switching Networks," *IEEE Journal on Selected Areas in Communications*, Apr. 1990, vol. 8, No. 1, pp. 380–390.
- Li, L. et al., "Real-time Synchronization Control in Multimedia Distributed Systems," pp. 294–305.
- Li, S. et al., "VC collaborator: a mechanism for video conferencing support*," Proceedings of SPIE, Oct. 1995, pp. 89–99.
- Mathy, L. and Bonaventure, O., "The ACCOPI Multimedia Transport Service over ATM," Proceedings of 2ndCOST237 Workshop on Teleservices and Multimedia Communication, Nov. 20–22, 1995, pp. 159–175.
- Mathy, L. et al., "A Group Communication Framework," Broadband Islands '94: Connecting with the End-user, 1994, pp. 167–178.
- Mathy, L. et al., "Towards an Integrated Solution for Multimedia Communications," Rev. AIM, 1996, pp. 3–10.
- Mathy, L. and Bonaventure, O., "QoS Negotiation for Multicast Communications," Multimedia Transport and Teleservices Lecture Notes in Computer Science, 1994, pp. 199–218.
- McCanne, S. and Vetterli, M., "Joint Source/Channel Coding for Multicast Packet Video," Proceedings of the International Conference on Image Processing, Oct. 23–26, 1995, pp. 25–28.
- Mitzel, Danny J. et al., "An Architectural Comparison of ST-II and RSVP," 10 pages.
- Mitzel, Danny J. and Shenker, Scott, "Asymptotic Resource Consumption in Multicast Reservation Styles," ACM SIGCOMM '94 Conference, Aug. 1994, pp. 1–8.
- Moy, J., "Multicast Extensions to OSPF," Network Working Group Request for Comments: 1584, Mar. 1994, 83 pages.
- Nguyen, Mai-Huong et al., "MCMP: A Transport/Session Level Distributed Protocol for Desktop Conference Setup," Sep. 1996, vol. 14, No. 7, pp. 1404–1421.
- Nichols, Kathleen M., "Network Performance of Packet Video on a Local Area Network," IPCCC '92, Apr. 1–3, 1992, pp. 0659–0666.
- Nicolaou, Cosmos, "An Architecture for Real-Time Multimedia Communications Systems," *IEEE Journal on Selected Area Communications*, Apr. 1990, vol. 8, No. 1, pp. 391–400.
- Parsa, M. et al., "Scalable Internet Multicast Routing," 4th International Conference on Computer Communications and Networks, Sep. 20–23, 1995, pp. 162–166.
- Partridge, C., "A Proposed Flow Specification," Network Working Group Request for Comments: 1363, Sep. 1992, 17 pages.
- Pasquale, Joseph C. et al., "The Multimedia Multicast Channel," *Internetworking Research and Experience*, 1994, vol. 5, pp. 151–162.
- Pasquale, Joseph C. et al., "The multimedia multicasting problem," *Multimedia Systems*, 1998, pp. 43–59.
- Rangan, P. Venkat, "Communication Architectures and Algorithms for Media Mixing in Multimedia Conferences," *IEEE/ACM Transactions on Networking*, 1993, pp. 20–30.
- Reibman, Amy R. and Berger, Arthur W., "Traffic Descriptors for VBR Video Teleconferencing Over ATM Networks," *IEEE/ACM Transactions on Networking*, Jun. 1995, vol. 3, No. 3, pp. 329–339.
- Robinson, John et al., "A Multimedia Interactive Conferencing Application for Personal Workstations," *IEEE Transactions on Communications*, Nov. 1991, pp. 1698–1708.
- Robinson, John A., "Communications services architecture for CSCW," *Computer Communications*, May 1994, vol. 17, No. 5, pp. 339–347.
- Sabri, Shaker and Prasada, Birendra, "Video Conferencing Systems," Proceedings of the IEEE, Apr. 1985, vol. 73, No. 4, pp. 671–688.
- Sakata, Shiro, "Multimedia and Multi-party Desktop Conference System (MERMAID) as Groupware Platform," IEEE Region 10's Ninth Annual International Conference Proceedings, Aug. 1994, pp. 739–743.
- Sasse, M.-A. et al., "Workstation-based multimedia conferencing: Experiences from the MICE project," *Integrating Telecommunication and Information Technology on the Desktop*, 1994, pp. 1–6.
- Schmandt, Chris and McKenna, Michael A., "An Adio and Telephone Server for Multi-media Workstations," 2nd IEEE Conference on Computer Workstations, Mar. 7–10, 1988, pp. 150–159.
- Schooler, Eve M. and Casner, Stephen L., "An Architecture for Multimedia Connection Management," Reprinted from the Proceedings IEEE 4th Comsoc International Workshop on Multimedia Communications, Apr. 1992, pp. 271–274.
- Schooler, Eve M., "Case Study: Multimedia Conference Control in a Packet-Switched Teleconferencing System," Reprinted from the *Journal of Internetworking: Research and Experience*, Jun. 1993, vol. 4, No. 2, pp. 99–120.
- Schooler, Eve M., "A Distributed Architecture for Multimedia Conference Control," ISI Research Report No. ISI/RR-91-289, Nov. 1991, pp. 1–18.
- Schooler, Eve M. et al., "Multimedia Conferencing: Has it come of age?" Reprinted from the Proceedings 24th Hawaii International Conference on Systems Sciences, Jan. 1991, vol. 3, pp. 707–716.
- Soman, Sadhna and Singh, Suresh, "An Experimental study of Video Conferencing over the Internet," IEEE Globecom '94, 1994, pp. 720–724.
- Strigini, Lorenzo et al., "Multicast Services on High-Speed Interconnected LANs," *High Speed Local Area Networks*, 1987, pp. 173–176.
- Tanigawa, Hiroya et al., "Personal Multimedia-Multipoint Teleconference System, 1991, pp. 1127–1134.
- Tassioulas, Leandros and Ephremides, Anthony, "Dynamic Server Allocation to Parallel Queues with Randomly Varying Connectivity," *IEEE Transactions on Information Theory*, Mar. 1993, vol. 39, No. 2, pp. 466–478.
- Tillman, Matthew A. and Yen, David, "SNA and OSI: Three Strategies for Interconnection," *Communications of the ACM*, Feb. 1990, vol. 33, No. 2, pp. 214–224.

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.