

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

(10) **Patent No.:** **US 6,393,497 B1**
(45) **Date of Patent:** **May 21, 2002**

(54) **DOWNLOADABLE SMART PROXIES FOR PERFORMING PROCESSING ASSOCIATED WITH A REMOTE PROCEDURE CALL IN A DISTRIBUTED SYSTEM**

5,297,283 A 3/1994 Kelly, Jr. et al.
5,307,490 A 4/1994 Davidson et al.
5,311,591 A 5/1994 Fischer
5,339,435 A 8/1994 Lubkin et al.
5,386,568 A 1/1995 Wold et al.

(75) Inventors: **Kenneth C. R. C. Arnold**, Lexington;
James H. Waldo, Dracut; **Robert Scheifler**, Somerville; **Ann M. Wollrath**, Groton, all of MA (US)

(List continued on next page.)

(73) Assignee: **Sun Microsystems, Inc.**, Palo Alto, CA (US)

FOREIGN PATENT DOCUMENTS

EP 0 300 516 A2 1/1989
EP 0 351 536 A3 1/1990
EP 0 384 339 A3 8/1990
EP 0 472 874 A1 3/1992

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

(List continued on next page.)

(21) Appl. No.: **09/044,930**

(22) Filed: **Mar. 20, 1998**

(51) **Int. Cl.**⁷ **G06F 13/00**

(52) **U.S. Cl.** **709/330; 709/315**

(58) **Field of Search** **709/300, 303, 709/310, 315, 330**

OTHER PUBLICATIONS

Sun Microsystems, Java Remote Method Invocation Specification, Feb. 10, 1997, pp. 18–23.*

Aldrich et al., “Providing Easier Access to Remote Objects in Client–Server Systems,” System Sciences, 1998, Proceedings of the 31st Hawaii Internat’l. Conference, Jan. 6–9, 1998, pp. 366–375.

(List continued on next page.)

(56) **References Cited**

U.S. PATENT DOCUMENTS

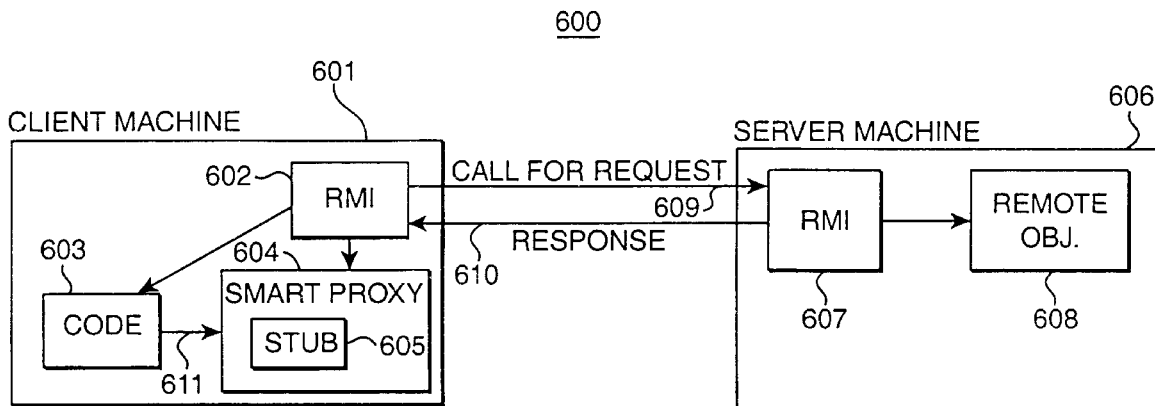
4,491,946 A 1/1985 Kryskow, Jr. et al.
4,713,806 A 12/1987 Oberlander et al.
4,809,160 A 2/1989 Mahon et al.
4,823,122 A 4/1989 Mann et al.
4,939,638 A 7/1990 Stephenson et al.
4,956,773 A 9/1990 Saito et al.
5,088,036 A 2/1992 Ellis et al.
5,109,486 A 4/1992 Seymour
5,187,787 A 2/1993 Skeen et al.
5,218,699 A 6/1993 Brandle et al.
5,257,369 A 10/1993 Skeen et al.
5,293,614 A 3/1994 Ferguson et al.

Primary Examiner—Kenneth R. Coulter
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.

(57) **ABSTRACT**

Use of a smart proxy as a wrapper around a stub in a distributed system. Instead of receiving a stub as a result of a remote procedure call, a caller receives a smart proxy including the stub as an embedded object. The smart proxy performs predefined processing associated with a remote procedure call, the processing possibly occurring before, during, or after a response to the call.

18 Claims, 8 Drawing Sheets



U.S. PATENT DOCUMENTS

5,390,328	A	2/1995	Frey et al.	5,832,593	A	11/1998	Wurst et al.
5,423,042	A	6/1995	Jalili et al.	5,835,737	A	11/1998	Sand et al.
5,440,744	A	8/1995	Jacobson et al.	5,842,018	A	11/1998	Atkinson et al.
5,448,740	A	9/1995	Kiri et al.	5,844,553	A	12/1998	Hao et al.
5,452,459	A	9/1995	Drury et al.	5,845,129	A	12/1998	Wendorf et al.
5,455,952	A	10/1995	Gjovaag	5,860,004	A	1/1999	Fowlow et al.
5,471,629	A	11/1995	Risch	5,860,153	A	1/1999	Matena et al.
5,475,792	A	12/1995	Stanford et al.	5,864,862	A	1/1999	Kriens et al.
5,475,817	A	12/1995	Waldo et al.	5,864,866	A	1/1999	Henckel et al.
5,481,721	A	1/1996	Serlet et al.	5,872,928	A	2/1999	Lewis et al.
5,504,921	A	4/1996	Dev et al.	5,872,973	A	* 2/1999	Mitchell et al. 709/332
5,511,197	A	4/1996	Hill et al.	5,875,335	A	2/1999	Beard
5,524,244	A	6/1996	Robinson et al.	5,878,411	A	3/1999	Borroughs et al.
5,548,726	A	8/1996	Pettus	5,884,024	A	3/1999	Lim et al.
5,553,282	A	9/1996	Parrish et al.	5,884,079	A	3/1999	Furusawa
5,555,367	A	9/1996	Premierani et al.	5,887,134	A	3/1999	Ebrahim
5,555,427	A	* 9/1996	Aoe et al. 709/201	5,889,951	A	3/1999	Lombardi
5,557,798	A	9/1996	Skeen et al.	5,890,158	A	3/1999	House et al.
5,560,003	A	9/1996	Nilsen et al.	5,892,904	A	4/1999	Atkinson et al.
5,561,785	A	10/1996	Blandy et al.	5,933,497	A	8/1999	Beetcher et al.
5,577,231	A	11/1996	Scalzi et al.	5,935,249	A	8/1999	Stern et al.
5,594,921	A	1/1997	Pettus	5,940,827	A	8/1999	Hapner et al.
5,603,031	A	2/1997	White et al.	5,944,793	A	8/1999	Islam et al.
5,617,537	A	4/1997	Yamada et al.	5,946,485	A	8/1999	Weeren et al.
5,628,005	A	5/1997	Hurvig	5,946,694	A	8/1999	Copeland et al.
5,640,564	A	6/1997	Hamilton et al.	5,956,509	A	9/1999	Kevner
5,644,768	A	7/1997	Periwal et al.	5,966,531	A	10/1999	Skeen et al.
5,652,888	A	7/1997	Burgess	5,969,967	A	10/1999	Aahlad et al.
5,655,148	A	8/1997	Richman et al.	5,987,506	A	11/1999	Carter et al.
5,659,751	A	8/1997	Heninger	5,999,179	A	12/1999	Kekic et al.
5,671,225	A	9/1997	Hooper et al.	6,003,763	A	12/1999	Gallagher et al.
5,675,796	A	10/1997	Hodges et al.	6,009,103	A	12/1999	Woundy
5,680,573	A	10/1997	Rubin et al.	6,016,496	A	1/2000	Roberson
5,680,617	A	10/1997	Gough et al.	6,026,414	A	* 2/2000	Anglin 707/204
5,684,955	A	11/1997	Meyer et al.	6,031,977	A	2/2000	Pettus
5,689,709	A	11/1997	Corbett et al.	6,061,699	A	5/2000	DiCecco et al.
5,706,435	A	1/1998	Barbará et al.	6,061,713	A	5/2000	Bharadhwaj
5,706,502	A	1/1998	Foley et al.	6,223,217	B1	* 4/2001	Pettus 709/219
5,724,588	A	3/1998	Hill et al.	6,260,076	B1	* 7/2001	Savitzky et al. 709/315
5,727,145	A	3/1998	Nessett et al.				
5,737,607	A	4/1998	Hamilton et al.				
5,745,678	A	4/1998	Herzberg et al.				
5,745,695	A	4/1998	Gilchrist et al.				
5,745,703	A	4/1998	Cejtin et al.				
5,745,755	A	4/1998	Covey				
5,748,897	A	* 5/1998	Katiyar 709/219				
5,754,849	A	5/1998	Dyer et al.				
5,757,925	A	5/1998	Faybishenko				
5,761,656	A	6/1998	Ben-Shachar				
5,764,897	A	6/1998	Khalidi				
5,768,532	A	6/1998	Megerian				
5,774,551	A	6/1998	Wu et al.				
5,778,187	A	7/1998	Monteiro et al.				
5,778,228	A	7/1998	Wei				
5,778,368	A	7/1998	Hogan et al.				
5,787,425	A	7/1998	Bigus				
5,787,431	A	7/1998	Shaughnessy				
5,790,548	A	8/1998	Sistanizadeh et al.				
5,802,367	A	9/1998	Held et al.				
5,808,911	A	9/1998	Tucker et al.				
5,809,507	A	9/1998	Cavanaugh, III				
5,812,819	A	9/1998	Rodwin et al.				
5,813,013	A	9/1998	Shakib et al.				
5,815,149	A	9/1998	Mutschler, III et al.				
5,815,709	A	9/1998	Waldo et al.				
5,815,711	A	9/1998	Sakamoto et al.				
5,818,448	A	* 10/1998	Katiyar 345/355				
5,829,022	A	10/1998	Watanabe et al.				
5,832,219	A	11/1998	Pettus				
5,832,529	A	11/1998	Wollrath et al.				

FOREIGN PATENT DOCUMENTS

EP	0 474 340	A2	3/1992
EP	0 497 022	A1	8/1992
EP	0 555 997	A2	8/1993
EP	0 565 849	A2	10/1993
EP	0 569 195	A3	11/1993
EP	0 625 750	A2	11/1994
EP	0 635 792	A2	1/1995
EP	0 651 328	A1	5/1995
EP	0 660 231	A2	6/1995
EP	0 697 655	A2	2/1996
EP	0 718 761	A1	6/1996
EP	0 767 432	A2	4/1997
EP	0 778 520	A2	6/1997
EP	0 794 493	A2	9/1997
EP	0 803 810	A2	10/1997
EP	0 803 811	A	10/1997
EP	0 805 393	A2	11/1997
EP	0 810 524	A	12/1997
EP	0 817 020	A	1/1998
EP	0 817 022	A2	1/1998
EP	0 817 025	A	1/1998
EP	0 836 140	A2	4/1998
GB	2 253 079	A	8/1992
GB	2 262 825	A	6/1993
GB	2 305 087	A	3/1997
JP	11-45187		2/1999

WO	WO 92/07335	4/1992
WO	WO 92/09948	6/1992
WO	WO93/25962 A1	12/1993
WO	WO 94/03855	2/1994
WO	WO 96/03692 A1	2/1996
WO	WO 96/10787	4/1996
WO	WO 96/18947	6/1996
WO	WO 96/24099	8/1996
WO	WO 98/02814	1/1998
WO	WO 98/04971	2/1998

OTHER PUBLICATIONS

- Aldrich et al., "Providing Easier Access to Remote Objects in Distributed Systems," Calif. Institute of Technology, www.cs.caltech.edu/%7Ejedi/paper/jedipaper.html, Nov. 21, 1997.
- Burns et al., "An Analytical Study of Opportunistic Lease Renewal," Distributed Computing Systems, 21st International Conference, pp. 146–153, Apr. 2000.
- Dollimore et al., "The Design of a System for Distributing Shared Objects," The Computer Journal, No. 6, Cambridge, GB, Dec. 1991.
- Fleisch et al., "High Performance Distributed Objects Using Distributed Shared Memory & Remote Method Invocation," System Sciences, 1998, Proceedings of the 31st Hawaii International Conference, Jan. 6–9, 1998, pp. 574–578.
- Gray et al., "Leases: An Efficient Fault-Tolerant Mechanism for Distributed File Cache Consistency," Proceedings of the 12th ACM Symposium on Operating Systems Principles, pp. 202–210, 1989.
- Guyennet et al., "A New Consistency Protocol Implemented in the CALIF System," IEEE, 1094–7256/97, pp. 82–87, 1997.
- Guyennet et al., "Distributed Shared Memory Layer for Cooperative Work Applications," IEEE, 0742–1303/97, pp. 72–78, 1997.
- Hoshi et al., "Allocation of the Cross-Connect Function in Leased Circuit Networks," 1992, ICC'92, conference record, SUPERCOMM/ICC '92, D a New World of Communications, IEEE International Conference, pp. 1408–1412.
- IBM Technical Disclosure Bulletin, "Local Network Monitoring to Populate Access Agent Directory," vol. 36, No. 09A, pp. 403–405, Sep. 1993.
- McGrath, "Discovery and Its Discontents: Discovery Protocols for Ubiquitous Computing," Presented at Center for Excellence in Space Data and Information Science, NASA Goddard Space Flight Center, Apr. 5, 2000.
- MUX-Elektronik, Java 1.1 Interactive Course, www.IIs.se/~mux/javaic.html, 1995.
- Stevenson, "Token-Based Consistency of Replicated Servers," IEEE, CH2686–4/89/0000/0179, pp. 179–183, 1989.
- Yin et al., "Using Leases to Support Server Driven Consistency in Large-Scale Systems," Computer Services Department, University of Texas at Austin, pp. 285–294, May 26–28, 1998.
- Yin et al., "Volume Leases for Consistency in Large-Scale Systems," IEEE Transactions on Knowledge & Data Engineering, vol. 11, No. 4, pp. 563–576, Jul./Aug. 1999.
- Mullender, *Distributed Systems*, Second Edition, Addison-Wesley, 1993.
- Howard et al., Scale and Performance in a Distributed File System, ACM Transactions on Computer Systems, vol. 6, No. 1, Feb. 1988, pp. 51–81.
- Cardelli, *Obliq, A lightweight language for network objects*, Nov. 5, 1993, pp. 1–37.
- Dijkstra, Self-stabilizing Systems in Spite of Distributed Control, Communications of the ACM, vol. 17, No. 11, Nov. 1974, pp. 643–644.
- Ousterhout et al., The Sprite Network Operating System, Computer, IEEE, Feb. 1988, pp. 23–36.
- Dourish, A Divergence-Based Model of Synchrony and Distribution in Collaborative Systems, Xerox Technical Report EPC-1194-102, 1994, pp. 1–10.
- Sharrott et al., ObjectMap: Integrating High Performance Resources into a Distributed Object-oriented Environment, ICODP, 1995.
- Birrell et al., Grapevine: An Exercise in Distributed Computing, Communications of the ACM, vol. 25, No. 4, Apr. 1982, pp. 260–274.
- Transparent Network Computing*, Locus Computing Corporation, Jan. 5, 1995.
- Gray et al., Leases: An Efficient Fault-Tolerant Mechanism for Distributed File Cache Consistency, ACM, 1989, pp. 202–210.
- Lampert et al., The Byzantine Generals Problem, ACM Transactions on Programming Languages and Systems, vol. 4, No. 3, Jul. 1982, pp. 382–401.
- Dolev et al., On the Minimal Synchronism Needed for Distributed Consensus, Journal of the ACM, vol. 34, No. 1, Jan. 1987, pp. 77–97.
- Mummert et al., *Long Term Distributed File Reference Tracing: Implementation and Experience*, Carnegie Mellon University School of Computer Science, Nov. 1994, pp. 1–28.
- Gelernter et al., *Parallel Programming in Linda*, Yale University, Jan. 1985, pp. 1–21.
- Cannon et al., Adding Fault-Tolerant Transaction Processing to LINDA, Software-Practice and Experience, vol. 24(5), May 1994, pp. 449–466.
- Kambhatla et al., *Recovery with Limited Replay: Fault-Tolerant Processes in Linda*, Oregon Graduate Institute, Technical Report CSIE 90-019, Sep. 1990, pp. 1–16.
- Anderson et al., Persistent Linda: Linda + Transactions + Query Processing, Proceedings of the 13th Symposium on Fault Tolerant Systems, 1994, pp. 93–109.
- Gelernter, Generative Communication in Linda, ACM Transactions on Programming Languages and Systems, vol. 7, No. 1, Jan. 1985, pp. 80–112.
- Carriero et al., Distributed Data Structures in Linda, Principals of Programming Language, 1986, pp. 1–16.
- Pinakis, *Using Linda as the Basis of an Operating System Microkernel*, University of Western Australia, Department of Computer Science, Aug. 1993, pp. 1–165.
- Linda Database Search, Jul. 20, 1995, pp. 1–68.
- Carriero et al., *Distributed Data Structures in Linda*, Yale Research Report YALEU/DCS/RR-438, Nov. 1985.
- Agha et al., *Actorspaces: An Open Distributed Programming Paradigm*, University of Illinois, Report No. UIUCDCS-R-92-1766, Open Systems Laboratory TR No. 8, Nov. 1992, pp. 1–12.
- Ahmed et al., *A Program Building Tool for Parallel Applications*, Yale University, Dec. 1, 1993, pp. 1–23.
- Liskov et al., *Distributed Object Management in Thor*, International Workshop on Distributed Object Management, 1992, pp. 12.
- Coulouris et al., *Distributed Systems Concepts and Designs*, Second Edition, Addison-Wesley, 1994.

- Birrell et al., *Network Objects*, DEC SRC Research Report 115, Feb. 28, 1994.
- Birrell et al., *Distributed Garbage Collection for Network Objects*, DEC SRC Research Report 116, Dec. 15, 1993.
- Jaworski, *Java 1.1 Developer's Guide*, Sams.net, 1997.
- Wollrath et al., A Distributed Object Model for the Java™ System, USENIX Association, Conference on Object-Oriented Technologies and Systems, Jun. 17–21, 1996.
- Harris et al., *Proposal for a General Java Proxy Class for Distributed Systems and Other Uses*, Netscape Communications Corp., Jun. 25, 1997.
- Hamilton, Java and the Shift to Net-Centric Computing Computer, Aug. 1996, pp. 31–39.
- Chung et al., A 'Tiny' Pascal Compiler: Part 1: The P-Code Interpreter, BYTE Publications, Inc., Sep. 1978.
- Chung et al., A 'Tiny' Pascal Compiler: Part 2: The P-Compiler, BYTE Publications, Inc., Oct. 1978.
- Thompson, Regular Expression Search Algorithm, Communications of the ACM, vol. II, No. 6, p. 149 et seq., Jun. 1968.
- Mitchell et al., *Mesa Language Manual*, Xerox Corporation.
- McDaniel, *An Analysis of a Mesa Instruction Set*, Xerox Corporation, May 1982.
- Pier, *A Retrospective on the Dorado, A High-Performance Personal Computer*, Xerox Corporation, Aug. 1983.
- Pier, *A Retrospective on the Dorado, A High-Performance Personal Computer*, IEEE Conference Proceedings, The 10th Annual International Symposium on Computer Architecture, 1983.
- Krasner, The Smalltalk-80 Virtual Machine, BYTE Publications Inc., Aug. 1991, pp. 300–320.
- Operating Systems Review, ACM Press, vol. 27, No. 5, Dec. 1993, pp. 217–230.
- Remote Method Invocation Specification, Sun Microsystems, Inc., (1997), <http://java.sun.com/products/jdk/1.1/docs/guide/rmi/spec/rmiTOC.doc.html>.
- Alexander, et al., "Active Bridging", Proceedings of the ACM/SIGCOMM'97 Conference, Cannes, France, 9/97.
- Anonymous: "Change-Notification Service for Share Files", IBM Technical Disclosure Bulletin, vol. 36, No. 8, pp. 77–82, Aug. 1993, XP002108713, New York, US.
- Anonymous: "Resource Preemption for Priority Scheduling." Nov. 1973. IBM Technical Disclosure Bulletin, vol. 16, No. 6, p. 1931 XP002109435 New York, US.
- Beech et al., "Object Databases as Generalizations of Relational Databases," Computer Standards & Interfaces, vol. 13, Nos. 1/3, pp. 221–230, (Jan. 1991) Amsterdam, NL.
- Bertino et al., "Object-Oriented Database Management Systems: Concepts and Issues," Computer, vol. 24, No. 4, pp. 33–47, (Apr. 1991), Los Alamitos, CA.
- Betz, Mark; "Interoperable objects: laying the foundation for distributed object computing"; Dr. Dobb's Journal, vol. 19, No. 11, p. 18(13); (Oct. 1994).
- Bevan, D.I., "An Efficient Reference Counting Solution To The Distributed Garbage Collection Problem", Parallel Computing, NL, Elsevier Publishers, Amsterdam, vol. 9, No. 2, pp. 179–192, Jan. 1989.
- Birrell et al., "Implementing Remote Procedure Calls", ACM Transactions on Computer Systems, vol. 2, No. 1, Feb. 1984, pp. 39–59.
- Dave A et al: "Proxies, Application Interface, and Distributed Systems", Proceedings International Workshop on Object Orientation in Operating Systems, Sep. 24, 1992, pp. 212–220.
- Deux O et al: "The O2 System" Communications of the Association for Computing Machinery, vol. 34, No. 10, Oct. 1, 1991, pp. 34–48.
- Drexler, K. Eric, et al., "Incentive Engineering for Computational Resource Management," The Ecology of Computation, Elsevier Science Publishers B.V., 1988, pp. 231–266.
- Droms, R., "RFC 1541 Dynamic Host Configuration Protocol", [HTTP://WWW.CIS.OHIO-STATE.EDU/HTBIN/RFC/RFC1541.HTML](http://www.cis.ohio-state.edu/htbin/rfc/rfc1541.html), Oct. 1993, pp. 1–33.
- Emms J: "A Definition of an Access Control Systems Language" Computer Standards and Interfaces, vol. 6, No. 4, Jan. 1, 1987, pp. 443–454.
- Gosling et al., "The Java (TM) Language Specification", Addison-Wesley, 1996.
- Gottlob et al., "Extending Object-Oriented Systems with Roles," ACM Transactions on information systems, vol. 14, No. 3, pp. 268–296 (Jul. 1996).
- Guth, Rob: "JavaOne: Sun to Expand Java Distributed Computing Effort", "[HTTP://WWW.SUNWORLD.COM/SWOL-02-1998/SWOL-02-SUNSPOTS.HTML](http://www.sunworld.com/SWOL-02-1998/SWOL-02-SUNSPOTS.HTML)," XP-002109935, p. 1, Feb. 20, 1998.
- Hamilton et al., "Subcontract: a flexible base for distributed programming"; Proceedings of 14th Symposium of Operating System Principles; (Dec. 1993).
- Hartman, J., Manber, U., et al., Liquid Software: A new paradigm for networked systems, Technical Report 96–11, Department of Comp. Sci., Univ. of Arizona, 6/96.
- Hunt, N., "IDF: A Graphical Data Flow Programming Language for Image Processing and Computer Vision", Proceedings of the International Conference on Systems, Man, and Cybernetics, Los Angeles, Nov. 4–7, pp. 351–360, (1990).
- IBM (TM) Technical Disclosure Bulletin, "Object Location Algorithm," vol. 36, No. 09B, pp. 257–258, Sep. 1993.
- IBM (TM) Technical Disclosure Bulletin, "Retrieval of Qualified Variables Using Extendible Hashing," vol. 36, No. 12, pp. 301–303, Dec. 1993.
- Jones, Richard, et al., "Garbage Collection: Algorithms for Automatic Dynamic Memory Management," pp. 165–175, John Wiley & Sons, 1996.
- Kay, Michael H. et al., "An Overview of the Raleigh Object-Oriented Database System", ICL Technical Journal, vol. 7, No. 4, pp. 780–798, (Nov. 1991), Oxford, GB.
- Kougiouris et al.; "Support for Space Efficient Object Invocation in Spring"; (Sep. 1994).
- Lindholm et al., "The Java (TM) Virtual Machine Specification", Addison Wesley, 1996.
- Mitchell et al.; "An Overview of the Spring System"; (Feb. 1994).
- Riggs Roger et al., "Picking State in the Java (TM) System," USENIX Association Conference on Object-Oriented Technologies and Systems, XP-002112719, Jun. 17–21, 1996, pp. 241–250.
- Rosenberry et al., "Understanding DCE"; Chapters 1–3, 6; (1992).
- Waldo J et al: "Events in an RPC based distributed system" Proceedings of the 1995 USENIX Technical Conference, Proceedings USENIX Winter 1995 Technical Conference, New Orleans, LA. USA, Jan. 16–20, 1995, pp. 131–142.
- Wilson, P.R., et al., "Design of the Opportunistic Garbage Collector," Proceedings of the Object Oriented Programming Systems Languages And Applications Conference, New Orleans, vol. 24, No. 10, Oct. 1989.

Wu, Xuequn, "A Type system for an Object-Oriented Database System," Proceedings of the International Computer Software and Applications Conference (COMPSAC), pp. 333-338, Sep. 11-13, 1991, Tokyo, Japan.

Yemini, Y. and S. da silva, "Towards Programmable Networks" IFIP/IEEE International Workshop on Distributed Systems: Operations and Management, L'Aquila, Italy, 10/96.

Birrell et al., Implementing Remote Procedure Calls, ACM Transactions on Computer Systems, vol. 2, No. 1, Feb. 1984, pp. 39-59.

IBM: Somobjects Developer Toolkit Users Guide, Version 2.1, "Chapter 6 Distributed SOM (DSOM)," pp 6-1-6-90, Oct. 1994.

Orfali R. et al., "The Essential Distributed Objects Survival Guide," Chapter 11: Corba Commercial ORBs, John Wiley & Sons, Inc., (1996).

Venners, B., "Jini Technology, Out of the Box", Javaworld, Online!, pp 1-4, Dec. 1998.

* cited by examiner

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.