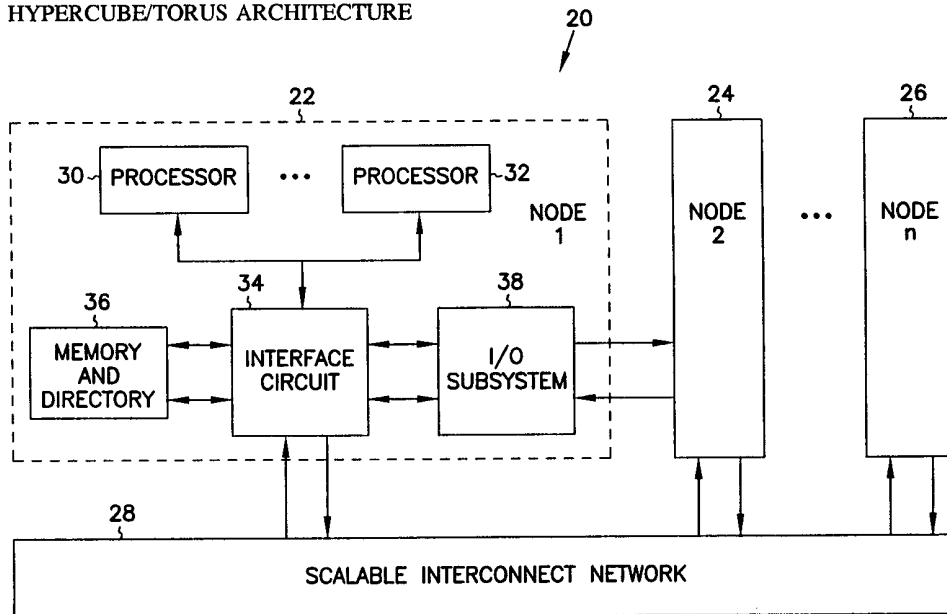




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<p>(21) International Application Number: PCT/US98/24493 (22) International Filing Date: 17 November 1998 (17.11.98) (30) Priority Data: 08/971,588 17 November 1997 (17.11.97) US (71) Applicant: CRAY RESEARCH, INC. [US/US]; 655-A Lone Oak Drive, Eagan, MN 55121 (US). (72) Inventors: PASSINT, Randal, S.; 90 Grady Drive, Chippewa Falls, WI 54729 (US). THORSON, Greg; 1119 Sweet Water Close, Altoona, WI 54720 (US). GALLES, Michael, B.; 1112 South Springer Road, Los Altos, CA 94024 (US). (74) Agent: VIKSNINS, Ann, S.; Schwegman, Lundberg, Woessner & Kluth, P.O. Box 2938, Minneapolis, MN 55402 (US).</p>		<p>(81) Designated States: JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 12 August 1999 (12.08.99)</p>

(54) Title: HYBRID HYPERCUBE/TORUS ARCHITECTURE



(57) Abstract

A system and method for communicating between a plurality of processing element nodes within a scalable multiprocessor system. Each processing element node includes at least one processor and memory. A scalable interconnect network includes physical communication links interconnecting the processing element nodes in an n-dimensional topology. Routers in the scalable interconnect network route messages between the plurality of processing element nodes on the physical communication links. The routers are capable of routing messages in hypercube topologies of up to six dimensions, and further capable of routing messages in at least one n-dimensional torus or mesh topology, wherein the topology has at least one of the n dimensions having a radix greater than four.

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INTERNATIONAL SEARCH REPORT

Int. l. Application No

PCT/US 98/24493

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06F15/173

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 625 836 A (I. B. M.) 29 April 1997 see column 3, line 60 - column 4, line 47 see column 7, line 32 - column 17, line 22 see column 23, line 20 - column 44, line 18; figures	1-14
A	US 5 682 479 A (NEWHALL ET AL.) 28 October 1997 see column 4, line 17 - column 10, line 49 see column 19, line 23 - column 26, line 27; figure 24	1-14
A	J. LAUDON, D. LENOSKI: "The SGI origin: A ccNUMA highly scalable server" 1997 ACM, 2 June 1997, pages 241-251, XP000738161 see the whole document	1-14

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Name and mailing address of the ISA
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NL - 2280 HV Rijswijk
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Information on patent family members

International Application No

PCT/US 98/24493

Patent document cited in search report	Publication date	Patent family member(s)	Publication date				
US 5625836	A	29-04-1997	JP 2579419 B 05-02-1997				
			JP 6139200 A 20-05-1994				
			CA 2050166 A 14-05-1992				
			CN 1061482 A 27-05-1992				
			CZ 9103440 A 17-05-1995				
			EP 0485690 A 20-05-1992				
			HU 215139 B 28-09-1998				
			JP 4267466 A 24-09-1992				
			KR 9616880 B 26-12-1996				
			PL 167329 B 31-08-1995				
			SK 344091 A 05-01-1995				
			RU 2084953 C 20-07-1997				
			US 5765011 A 09-06-1998				
			US 5794059 A 11-08-1998				
			US 5765012 A 09-06-1998				
			US 5822608 A 13-10-1998				
			US 5615360 A 25-03-1997				
			US 5517642 A 14-05-1996				
			US 5615309 A 25-03-1997				
			US 5617577 A 01-04-1997				
			US 5630162 A 13-05-1997				
			US 5765015 A 09-06-1998				
			US 5809292 A 15-09-1998				
			US 5717943 A 10-02-1998				
			US 5710935 A 20-01-1998				
			US 5842031 A 24-11-1998				
			US 5752067 A 12-05-1998				
			US 5717944 A 10-02-1998				
			US 5878241 A 02-03-1999				
			US 5713037 A 27-01-1998				
			US 5754871 A 19-05-1998				
			US 5708836 A 13-01-1998				
			US 5761523 A 02-06-1998				
			US 5588152 A 24-12-1996				
	US 5828894 A 27-10-1998						
	US 5734921 A 31-03-1998						
	US 5815723 A 29-09-1998						
	US 5870619 A 09-02-1999						
	US 5590345 A 31-12-1996						
	AT 177547 T 15-03-1999						
	CA 2073516 A 28-05-1993						
	CN 1072788 A 02-06-1993						
	DE 69228586 D 15-04-1999						
	EP 0544127 A 02-06-1993						
	JP 2647315 B 27-08-1997						
	KR 9708529 B 24-05-1997						
	MX 9206864 A 01-05-1993						
	US 5475856 A 12-12-1995						
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">US 5682479</td> <td style="width: 5%;">A</td> <td style="width: 25%;">28-10-1997</td> <td style="width: 45%;">NONE</td> </tr> </table>				US 5682479	A	28-10-1997	NONE
US 5682479	A	28-10-1997	NONE				