



US007281055B2

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

(10) **Patent No.:** **US 7,281,055 B2**  
(45) **Date of Patent:** **Oct. 9, 2007**

(54) **ROUTING MECHANISMS IN SYSTEMS HAVING MULTIPLE MULTI-PROCESSOR CLUSTERS**

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 797 days.

5,394,555 A	2/1995	Hunter et al.	
5,561,768 A	10/1996	Smith .....	712/13
5,623,644 A	4/1997	Self et al. ....	713/503
5,682,512 A *	10/1997	Tetrick .....	711/202
5,692,123 A	11/1997	Logghe	
5,781,187 A	7/1998	Gephardt et al.	
5,796,605 A *	8/1998	Hagersten .....	700/5
5,805,839 A *	9/1998	Singhal .....	710/112
5,819,075 A	10/1998	Forsmo	

(Continued)

FOREIGN PATENT DOCUMENTS

(21) Appl. No.: **10/156,893**

(22) Filed: **May 28, 2002**

(65) **Prior Publication Data**

US 2003/0225938 A1 Dec. 4, 2003

(51) **Int. Cl.**  
**G06F 15/16** (2006.01)  
**G06F 13/00** (2006.01)

(52) **U.S. Cl.** ..... **709/232; 709/217; 709/238; 711/148**

(58) **Field of Classification Search** ..... **709/217-219, 709/230-245, 212-216; 370/389-393; 712/10-15; 711/150, 147-148**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,667,287 A *	5/1987	Allen et al. ....	709/234
4,783,657 A	11/1988	Bouchard et al.	
4,783,687 A	11/1988	Rees	
5,125,081 A	6/1992	Chiba	
5,166,674 A *	11/1992	Baum et al. ....	714/752
5,191,651 A *	3/1993	Halim et al. ....	709/250
5,197,130 A *	3/1993	Chen et al. ....	712/3
5,301,311 A	4/1994	Fushimi et al. ....	714/23
5,371,852 A *	12/1994	Attanasio et al. ....	709/245

EP 0978781 2/2000

(Continued)

OTHER PUBLICATIONS

International Search Report dated Jul. 30, 2004, from corresponding PCT Application No. PCT/US2003/034687 (9 pages).

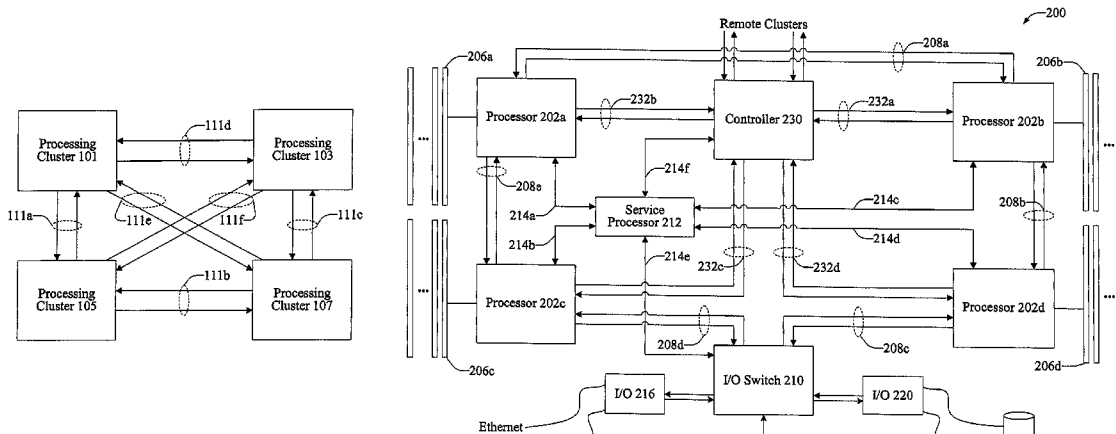
(Continued)

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(57) **ABSTRACT**

A multi-processor computer system is described in which address mapping, routing, and transaction identification mechanisms are provided which enable the interconnection of a plurality of multi-processor clusters, wherein the number of processors interconnected exceeds limited address, node identification, and transaction tag spaces associated with each of the individual clusters.

**18 Claims, 9 Drawing Sheets**



U.S. PATENT DOCUMENTS

5,822,531	A	10/1998	Gorczyca et al.	
5,931,938	A *	8/1999	Drogichen et al. ....	712/15
5,940,870	A *	8/1999	Chi et al. ....	711/206
6,003,075	A	12/1999	Arendt et al.	
6,018,791	A	1/2000	Arimilli et al.	
6,038,651	A	3/2000	VanHuben et al.	
6,047,332	A	4/2000	Viswanathan et al. ....	709/245
6,065,053	A	5/2000	Nouri et al.	
6,067,603	A	5/2000	Carpenter et al.	
6,085,295	A *	7/2000	Ekanadham et al. ....	711/145
6,097,707	A	8/2000	Hodzic et al. ....	370/321
6,151,663	A	11/2000	Pawlowski et al.	
6,167,492	A	12/2000	Keller et al. ....	711/154
6,192,451	B1	2/2001	Arimilli et al.	
6,209,065	B1 *	3/2001	Van Doren et al. ....	711/150
6,219,775	B1	4/2001	Wade et al. ....	712/11
6,226,671	B1	5/2001	Hagersten et al. ....	709/215
6,256,671	B1 *	7/2001	Strentzsch et al. ....	709/227
6,259,701	B1 *	7/2001	Shur et al. ....	370/401
6,330,643	B1	12/2001	Arimilli et al.	
6,331,983	B1 *	12/2001	Haggerty et al. ....	370/400
6,334,172	B1	12/2001	Arimilli et al.	
6,338,122	B1 *	1/2002	Baumgartner et al. ....	711/141
6,349,091	B1	2/2002	Li ....	370/238
6,370,585	B1 *	4/2002	Hagersten et al. ....	709/238
6,377,640	B2	4/2002	Trans	
6,378,029	B1 *	4/2002	Venkitakrishnan et al. .	710/317
6,385,174	B1	5/2002	Li ....	370/252
6,385,705	B1	5/2002	Keller et al. ....	711/154
6,397,255	B1 *	5/2002	Nurenberg et al. ....	709/228
6,405,289	B1	6/2002	Arimilli et al.	
6,463,529	B1	10/2002	Miller et al.	
6,467,007	B1	10/2002	Armstrong et al.	
6,490,661	B1 *	12/2002	Keller et al. ....	711/150
6,542,926	B2	4/2003	Zalewski et al.	
6,553,439	B1	4/2003	Greger et al.	
6,578,071	B2	6/2003	Hagersten et al. ....	709/215
6,598,130	B2 *	7/2003	Harris et al. ....	711/147
6,601,165	B2	7/2003	Morrison et al.	
6,615,319	B2	9/2003	Khare et al.	
6,631,447	B1	10/2003	Morioka et al.	
6,633,960	B1	10/2003	Kessler et al.	
6,675,253	B1	1/2004	Brinkmann et al.	
6,687,751	B1	2/2004	Wils et al. ....	709/230
6,690,757	B1	2/2004	Bunton et al.	
6,704,842	B1	3/2004	Janakiraman et al.	
6,718,552	B1	4/2004	Goode ....	725/95
6,751,698	B1	6/2004	Deneroff et al.	
6,754,782	B2 *	6/2004	Arimilli et al. ....	711/144
6,760,819	B2 *	7/2004	Dhong et al. ....	711/146
6,772,226	B1	8/2004	Bommareddy et al. ....	709/245
6,785,726	B1 *	8/2004	Freeman et al. ....	709/227
6,820,174	B2	11/2004	Vanderwiel	
6,826,660	B2	11/2004	Hagersten et al. ....	711/153
6,842,857	B2	1/2005	Lee et al.	
6,847,993	B1	1/2005	Novaes et al. ....	709/221
6,854,069	B2	2/2005	Kampe et al.	
6,856,621	B1 *	2/2005	Artes ....	370/390
6,865,595	B2	3/2005	Glasco et al.	
6,920,519	B1	7/2005	Beukema et al. ....	710/306
6,977,908	B2	12/2005	De Azevedo et al.	
7,010,617	B2	3/2006	Kampe et al.	
7,043,569	B1	5/2006	Chou et al.	
7,103,636	B2	9/2006	Glasco et al.	
7,103,823	B2	9/2006	Nemawarkar et al.	
7,117,419	B2 *	10/2006	Nemawarkar et al. ....	714/758
7,155,525	B2	12/2006	Glasco et al.	
7,222,262	B2	5/2007	Prasadh et al.	
2001/0014097	A1 *	8/2001	Beck et al. ....	370/401

2002/0004915	A1	1/2002	Fung .....	713/320
2002/0007463	A1	1/2002	Fung et al.	
2002/0052914	A1	5/2002	Zalewski et al.	
2002/0083149	A1	6/2002	Van Huben et al.	
2002/0083243	A1	6/2002	Van Huben et al.	
2002/0087811	A1	7/2002	Khare et al.	
2002/0156888	A1 *	10/2002	Lee et al. ....	709/224
2002/0157035	A1	10/2002	Wong et al.	
2002/0174168	A1	11/2002	Beukema et al.	
2003/0149844	A1 *	8/2003	Duncan et al. ....	711/141
2003/0196047	A1	10/2003	Kessler et al.	
2003/0212873	A1	11/2003	Lee et al.	
2003/0225909	A1	12/2003	Glasco et al. ....	709/245
2003/0233388	A1	12/2003	Glasco et al. ....	718/101
2004/0073755	A1	4/2004	Webb et al.	
2004/0098475	A1	5/2004	Zeitler et al. ....	709/223

FOREIGN PATENT DOCUMENTS

WO WO 02/39242 5/2002

OTHER PUBLICATIONS

*HyperTransport™ I/O Link Specification Revision 1.03*, HyperTransport™ Consortium, Oct. 10, 2001, Copyright© 2001 HyperTransport Technology Consortium.  
 D. E. Culler, J. P. Singh, A. Gupta, "Parallel Computer Architecture", 1999 Morgan Kaufmann, San Francisco, CA USA XP002277658.  
 Andrew Tanenbaum, "Computer Networks", Computer Networks, London: Prentice Hall International, GB, 1996, pp. 345-403, XP002155220.  
 Bossen et al., "Fault-tolerant design of the IBM pSeries 690 system POWER4 processor technology.", IBM J. Res. and Dev. vol. 46, No. 1, Jan. 2002.  
 Notice of Allowance mailed Nov. 30, 2004, from U.S. Appl. No. 10/157,340.  
 U.S. Office Action mailed Nov. 30, 2004, from U.S. Appl. No. 10/157,388.  
 Notice of Allowance mailed May 11, 2005, from U.S. Appl. No. 10/157,388.  
 Notice of Allowance mailed Aug. 27, 2005, from U.S. Appl. No. 10/157,388.  
 U.S. Office Action mailed Sep. 21, 2005, from U.S. Appl. No. 10/157,384.  
 U.S. Office Action mailed Jan. 30, 2006, from U.S. Appl. No. 10/157,384.  
 Notice of Allowance mailed Jun. 15, 2006, from U.S. Appl. No. 10/157,384.  
 Supplemental Notice of Allowance mailed Sep. 25, 2006, from U.S. Appl. No. 10/157,384.  
 U.S. Office Action mailed Sep. 21, 2005, from U.S. Appl. No. 10/157,409.  
 U.S. Office Action mailed Feb. 7, 2006, from U.S. Appl. No. 10/157,409.  
 U.S. Office Action mailed Jul. 6, 2006, from U.S. Appl. No. 10/157,409.  
 U.S. Office Action mailed Dec. 4, 2006, from U.S. Appl. No. 10/300,408.  
 U.S. Office Action mailed May 18, 2007, from U.S. Appl. No. 10/300,408.  
 U.S. Office Action mailed Apr. 18, 2006, from U.S. Application No. 10/356,393.  
 U.S. Office Action mailed Oct. 4, 2006, from U.S. Appl. No. 10/356,393.  
 U.S. Office Action mailed May 21, 2007, from U.S. Appl. No. 10/356,393.  
 U.S. Office Action mailed Aug. 14, 2006, from U.S. Appl. No. 10/635,700.  
 Notice of Allowance mailed Jan. 24, 2007, from U.S. Appl. No. 10/635,700.

## US 7,281,055 B2

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Notice of Allowance mailed Apr. 19, 2006, from U.S. Appl. No. 10/635,884.

U.S. Office Action mailed Feb. 2, 2006 from U.S. Appl. No. 10/635,705.

Notice of Allowance mailed Aug. 18, 2006, from U.S. Appl. No. 10/635,705.

U.S. Office Action mailed Nov. 15, 2005 from U.S. Appl. No. 10/635,793.

Notice of Allowance mailed May 23, 2006, from U.S. Appl. No. 10/635,793.

European Search report mailed Sep. 6, 2005, from European Application No. 03778027.7.

European Search report mailed Mar. 29, 2006, from European Application No. 03778027.7.

European Search report mailed Dec. 19, 2006, from European Application No. 03778027.7.

International Search Report dated Jan. 12, 2005, from PCT Application No. PCT/US2004/022935.

Written Opinion dated Jan. 12, 2005, from PCT Application No. PCT/US2004/022935.

Office Action mailed Apr. 18, 2006 in U.S. Appl. No. 10/356,393, filed Jan. 30, 2003.

European Search Report mailed Mar. 29, 2006 in Application No. 03 778 027.7-2211.

\* cited by examiner

Fig. 1A

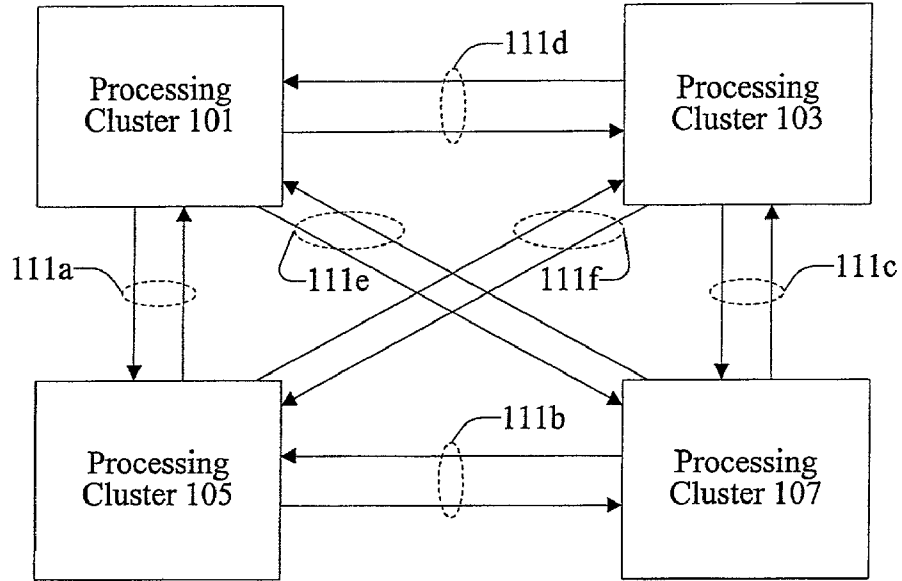


Fig. 1B

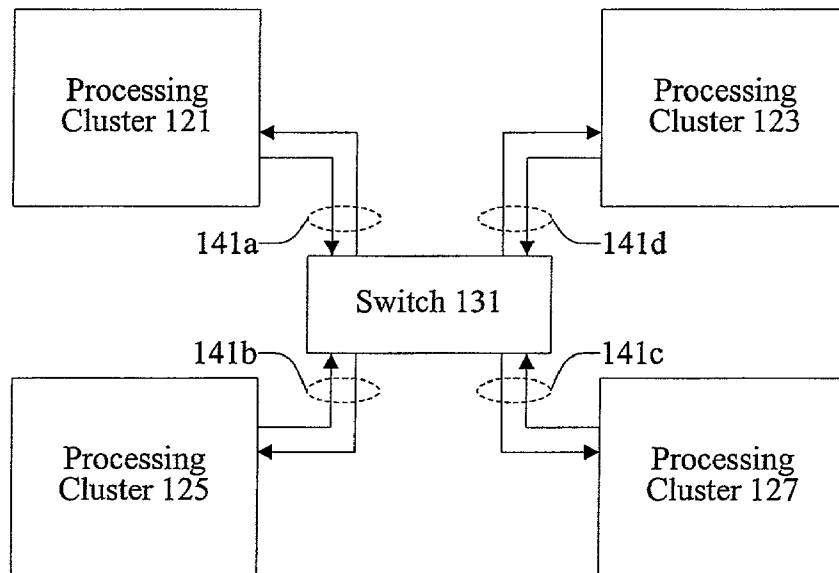
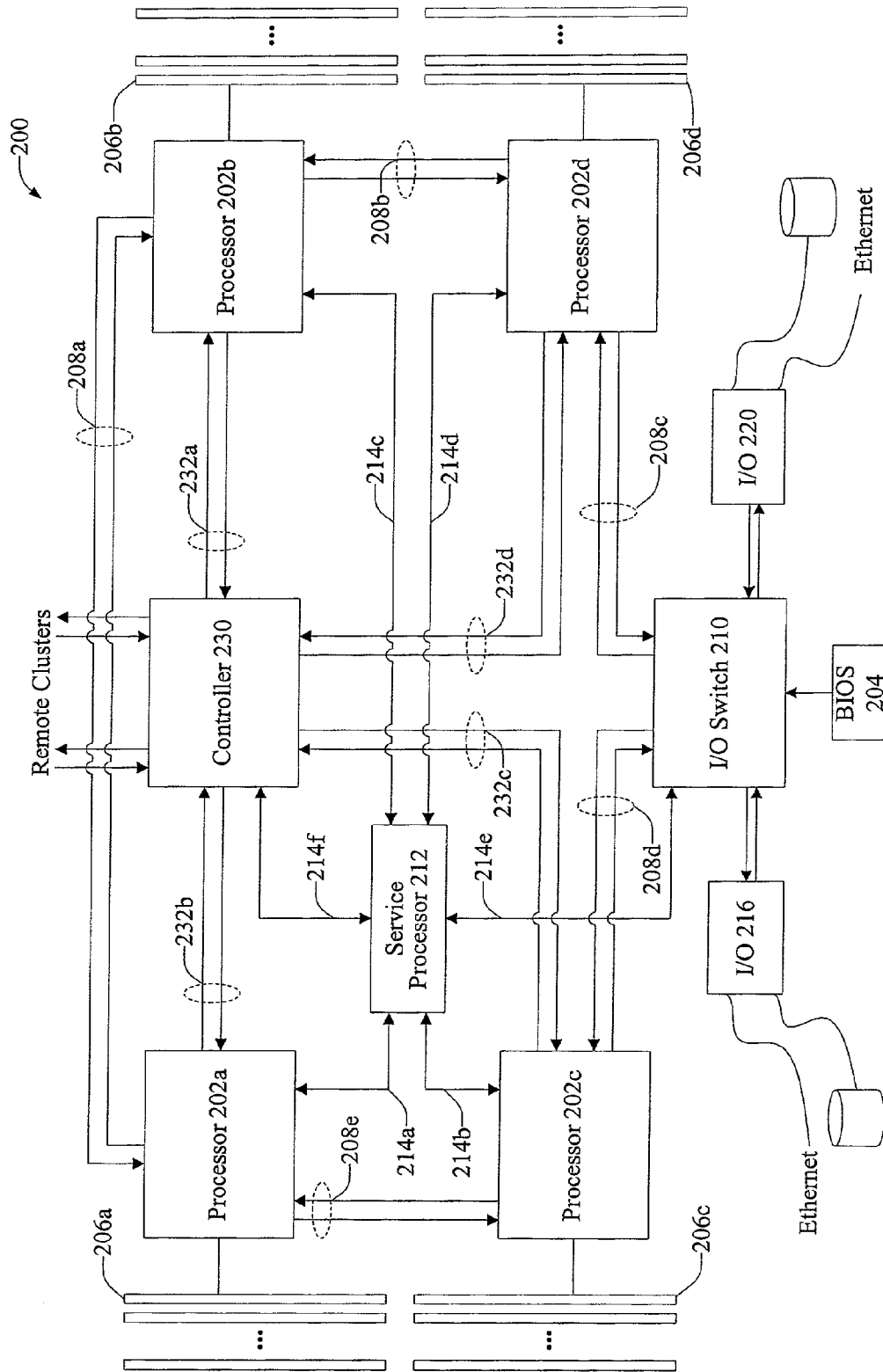


Fig. 2



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