(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date 22 December 2011 (22.12.2011)

(10) International Publication Number WO 2011/159411 A3

(51) International Patent Classification: *G06F 9/44* (2006.01) *G06F 9/38* (2006.01)

(21) International Application Number:

PCT/US2011/036532

(22) International Filing Date:

13 May 2011 (13.05.2011)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

12/819,097

18 June 2010 (18.06.2010)

US

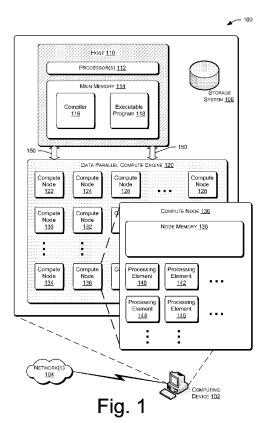
- (71) Applicant (for all designated States except US): MI-CROSOFT CORPORATION [US/US]; One Microsoft Way, Redmond, Washington 98052-6399 (US).
- (72) Inventors: CALLAHAN, Charles David, II; c/o Microsoft Corporation, LCA International Patents, One Microsoft Way, Redmond, Washington 98052-6399 (US).
 RINGSETH, Paul F.; c/o Microsoft Corporation, LCA International Patents, One Microsoft Way, Redmond,

Washington 98052-6399 (US). LEVANONI, Yosseff; c/o Microsoft Corporation, LCA - International Patents, One Microsoft Way, Redmond, Washington 98052-6399 (US). ZHU, Weirong; c/o Microsoft Corporation, LCA - International Patents, One Microsoft Way, Redmond, Washington 98052-6399 (US). ZHANG, Lingli; c/o Microsoft Corporation, LCA - International Patents, One Microsoft Way, Redmond, Washington 98052-6399 (US).

- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

[Continued on next page]

(54) Title: DATA PARALLEL PROGRAMMING MODEL



(57) Abstract: Described herein are techniques for enabling a programmer to express a call for a data parallel call-site function in a way that is accessible and usable to the typical programmer. With some of the described techniques, an executable program is generated based upon expressions of those data parallel tasks. During execution of the executable program, data is exchanged between non-data parallel (non-DP) capable hardware and DP capable hardware for the invocation of data parallel functions.

WO 2011/159411 A3

GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))
- (88) Date of publication of the international search report:

8 March 2012

International application No. **PCT/US2011/036532**

A. CLASSIFICATION OF SUBJECT MATTER

G06F 9/44(2006.01)i, G06F 9/38(2006.01)i

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) G06F 9/44; G06F 15/00; G06F 7/52

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS(KIPO internal) & Keywords: parallel, function, data set

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009-0307660 A1 (CHITOOR V. SRINIVASAN) 10 December 2009 See abstract and [0020] - [0584].	1-20
A	US 2003-0088601 A1 (NIKOS P. PITSIANIS et al.) 08 May 2003 See [0036] - [0104].	1-20
A	US 2007-0028076 A1 (MARTINUS CORNELIS WEZELENBURG) 01 February 2007 See [0006] - [0126].	1-20

		Further documents are l	listed in the	continuation	of Box C.
--	--	-------------------------	---------------	--------------	-----------

See patent family annex.

- * Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- 'E" earlier application or patent but published on or after the international
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

30 DECEMBER 2011 (30.12.2011)

Date of mailing of the international search report

02 JANUARY 2012 (02.01.2012)

Name and mailing address of the ISA/KR



Korean Intellectual Property Office Government Complex-Dacjeon, 189 Cheongsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KWON, Oh Seong

Telephone No. 82-42-481-8526



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

Patent document cited in search report Publication date Patent family member(s) EP 2350825 A2 03.08.2011 US 7979844 B2 12.07.2011 W0 2010-044915 A2 22.04.2010 US 2003-0088601 A1 O8.05.2003 CN 100566490 C 02.12.2009 CN 101142857 A0 12.03.2008 EP 1141819 A1 10.10.2001 EP 1862035 A1 05.12.2007 JP 2002-527808 A 27.08.2002 JP 2008-533270 A 21.08.2008 KR 10-2007-0111554 A 21.11.2007 US 2004-0221137 A1 04.11.2004 US 2008-0301414 A1 04.12.2008 US 2011-0181173 A1 28.07.2011 US 6839728 B2 04.01.2005 US 7879258 B2 04.01.2005 US 789258 B2 01.02.2011 US 2006-097876 A1 20.04.2000 W0 2006-097876 A1 21.09.2006 US 2007-0028076 A1 01.02.2007 US 2007-0028076 A1 6.02.2007
US 7979844 B2 12.07.2011 W0 2010-044915 A2 22.04.2010 US 2003-0088601 A1 08.05.2003 CN 100566490 C 02.12.2009 CN 101142857 A0 12.03.2008 EP 1141819 A1 10.10.2001 EP 1862035 A1 05.12.2007 JP 2002-527808 A 27.08.2002 JP 2008-533270 A 21.08.2008 KR 10-2007-0111554 A 21.11.2007 US 2004-0221137 A1 04.11.2004 US 2008-0301414 A1 04.12.2008 US 2008-0301414 A1 04.12.2008 US 2011-0181173 A1 28.07.2011 US 6839728 B2 04.01.2005 US 7879258 B2 01.02.2011 US 7879258 B2 01.02.2011 US 7962719 B2 14.06.2011 W0 00-22503 A1 20.04.2000 W0 2006-097876 A1 21.09.2006
CN 101142857 A0 12.03.2008 EP 1141819 A1 10.10.2001 EP 1862035 A1 05.12.2007 JP 2002-527808 A 27.08.2002 JP 2008-533270 A 21.08.2008 KR 10-2007-0111554 A 21.11.2007 US 2004-0221137 A1 04.11.2004 US 2008-0187746 A1 07.08.2008 US 2008-0301414 A1 04.12.2008 US 2011-0181173 A1 28.07.2011 US 6839728 B2 04.01.2005 US 7424594 B2 09.09.2008 US 7879258 B2 01.02.2011 US 7879258 B2 01.02.2011 US 7962719 B2 14.06.2011 W0 2006-097876 A1 21.09.2006
WO 2007-012794 A2 01.02.2007 WO 2007-012794 A3 01.02.2007