



- (51) International Patent Classification:  
*G06F 9/44* (2006.01)      *G06F 9/46* (2006.01)
- (21) International Application Number:  
PCT/US2011/064754
- (22) International Filing Date:  
14 December 2011 (14.12.2011)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
12/972,424    17 December 2010 (17.12.2010)      US
- (71) Applicant (for all designated States except US): **MI-CROSOFT CORPORATION** [US/US]; One Microsoft Way, Redmond, WA 98052-6399 (US).
- (72) Inventors: **SPRADLIN, Jeremiah, C.**; c/o Microsoft Corporation, LCA - International Patents, One Microsoft Way, Redmond, WA 98052-6399 (US). **FORTIER, Dominique**; c/o Microsoft Corporation, LCA - International Patents, One Microsoft Way, Redmond, WA 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, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, 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, GM, KE, LR, LS, MW, MZ, NA, RW, 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:**

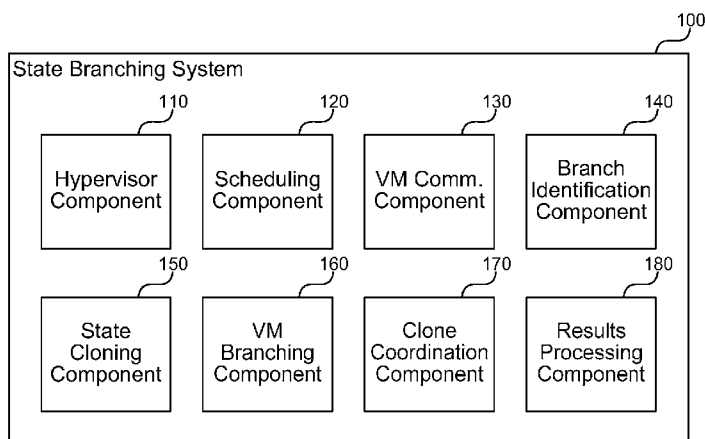
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

**Published:**

- with international search report (Art. 21(3))

[Continued on next page]

(54) Title: VIRTUAL MACHINE BRANCHING AND PARALLEL EXECUTION



**FIG. 1**

(57) Abstract: A state branching system is described herein that allows parallel execution of complex state transitions while leveraging time invested to setup a starting state. By allowing branching at the virtual machine level, the state branching system allows setup of a particular condition or state in a virtual machine, then copying and branching to parallel instances of the virtual machine to explore different possible subsequent states. Upon detecting a large state change with unknown outcome, the state branching system instructs the hypervisor to copy the executing virtual machine into one or more separate virtual machines. The system then allows divergent branching between the two or more virtual machines to explore different states from a similar starting point. Once the executions have reached the next state, the system coordinates to determine which copies will continue execution. Thus, the state branching system allows faster exploration of complex state changes.

WO 2012/082811 A3

— *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:**  
27 September 2012

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2011/064754****A. CLASSIFICATION OF SUBJECT MATTER****G06F 9/44(2006.01)i, G06F 9/46(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 9/46; G06F 9/455

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) &amp; Keywords: virtual, machine, branch, parallel, process, clone, original, creating, duplicate

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7664626 B1 (PETER FERRIE) 16 February 2010 See abstract; col. 7, lines 57-61, col. 12, lines 1-67, col. 17, lines 21-59,	1-2,5,9-10,12-13
A	col. 19, lines 46-61; figures 2A, 2B2; claim 1.	3-4,6-8,11,14-15
A	US 7784053 B2 (CHRISTINE E. CASEY et al.) 24 August 2010 See abstract; col. 3, line 61 - col. 4, line 62, col. 6, line 42 - col. 11, line 18; figures 2, 5A; claims 1,9.	1-15
A	US 2009-0037885 A1 (ANDREW J. EDWARDS et al.) 05 February 2009 See abstract; paragraphs [0020] - [0039]; figures 1-3; claim 1.	1-15
A	US 2008-0163210 A1 (MIC BOWMAN et al.) 03 July 2008 See abstract; paragraphs [0018] - [0023]; figure 1; claim 1.	1-15

 Further documents are 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 filing date

"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 means

"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

30 JULY 2012 (30.07.2012)

Date of mailing of the international search report

**30 JULY 2012 (30.07.2012)**

Name and mailing address of the ISA/KR

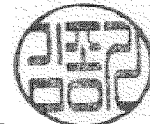
Korean Intellectual Property Office  
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan  
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KIM Jong Kee

Telephone No. 82-42-481-8301



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2011/064754**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7664626 B1	16.02.2010	None	
US 7784053 B2	24.08.2010	JP 03882930 B2 JP 2004-326754 A US 2004-0221290 A1 US 2007-0214456 A1 US 7299468 B2	21.02.2007 18.11.2004 04.11.2004 13.09.2007 20.11.2007
US 2009-0037885 A1	05.02.2009	None	
US 2008-0163210 A1	03.07.2008	CN 101211272 A CN 101211272 G0 EP 1939742 A2 EP 1939742 A3 JP 2008-165795 A KR 10-1031409 B1 KR 10-2011-0015495 A	02.07.2008 02.07.2008 02.07.2008 23.09.2009 17.07.2008 26.04.2011 16.02.2011