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- (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, BN, 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, KN, KP, KR,

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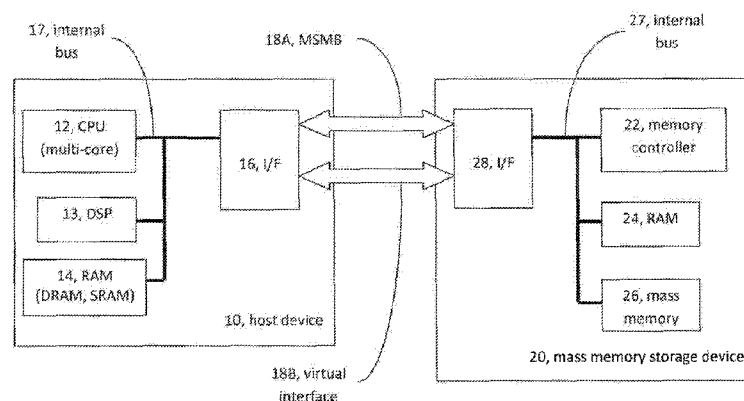
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(54) **Title:** VIRTUAL MEMORY MODULE**Figure 3**

(57) **Abstract:** A memory controller of a mass memory device determining that a memory operation has been initiated which involves the mass memory device, and in response dynamically checks for available processing resources of a host device that is operatively coupled to the mass memory device and thereafter puts at least one of the available processing resources into use for performing the memory operation. In various non-limiting examples: the available processing resources maybe a core engine of a multi-core CPU, a DPS or a graphics processor; central processing unit; a digital signal processor; and a graphics processor; and it may also be dynamically checked whether memory resources of the host are available and those can be similarly put into use (e.g., write data to a DRAM of the host, process data in the DRAM with the host DSP, then write the processed data to the mass memory device).

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/49434

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G06F 12/00 (2014.01)

USPC - 711/103

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(8): G06F 12/00 (2014.01)

USPC: 711/103

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

IPC(8): G06F 12/00 (2014.01)

USPC: 711/103, 711/105, 711/E12.008, 711/154

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

Patbase; Google (Scholar, Patent); Host, EPROM, EEPROM, memory, operation, task, mass memory, DRAM, NAND, available, resources, GPU, graphics processor, core engine, digital signal processor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010/0312947 A1 (Luukkainen et al.) 09 December 2010 (09.12.2010) entire document (especially para [0022], [0038]-[0041])	1-4, 10-13
A	US 2009/0164705 A1 (Gorobets) 25 June 2009 (25.06.2009) entire document (especially para [0047], [0052], [0081], [0104]-[0106])	1-4, 10-13
A	US 2011/0296088 A1 (Duzly et al.) 01 December 2011 (01.12.2011) entire document	1-4, 10-13
A	US 2009/0210615 A1 (Struk et al.) 20 August 2009 (20.08.2009) entire document	1-4, 10-13
A	US 2010/0030961 A9 (Ma et al.) 04 February 2010 (04.02.2010) entire document	1-4, 10-13
A	US 2008/0104291 A1 (Hinchey) 01 May 2008 (01.05.2008) entire document	1-4, 10-13
A	US 2011/0099326 A1 (Jung et al.) 28 April 2011 (28.04.2011) entire document	1-4, 10-13
A	US 6,115,785 A (Estakhri et al.) 05 September 2000 (05.09.2000) entire document	1-4, 10-13
A	US 2007/0207854 A1 (Wolf et al.) 06 September 2007 (06.09.2007) entire document	1-4, 10-13

☐ Further documents are listed in the continuation of Box C.

* 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 another 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

"&" document member of the same patent family

Date of the actual completion of the international search

12 March 2014 (12.03.2014)

Date of mailing of the international search report

16 APR 2014

Name and mailing address of the ISA/US

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/49434

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 5-9 and 14-20
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.