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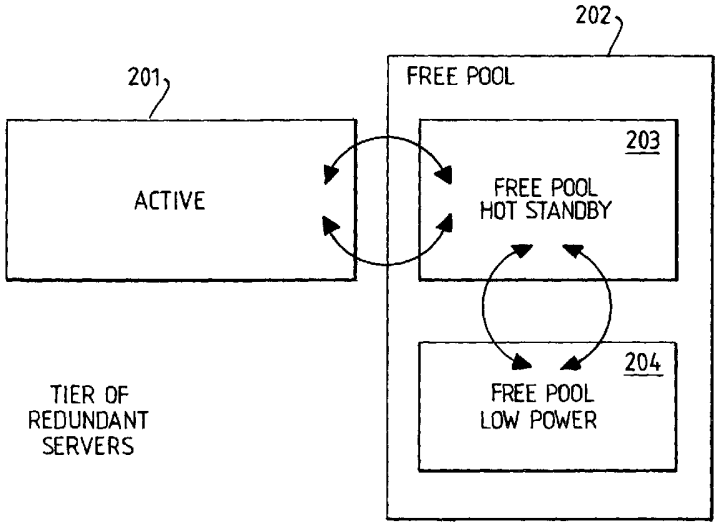
[Continued on next page]

(54) Title: AUTOMATED POWER CONTROL POLICIES FOR DISTRIBUTED SERVER POOLS BASED ON APPLICATION-SPECIFIC COMPUTATIONAL REQUIREMENTS



(57) Abstract: Power and redundancy management policies are applied individually to the tiers of redundant servers of an application service such that power is reduced while maintaining a high level of system availability. Servers which are determined to be relatively inactive are moved to a free pool. Certain servers of the free pool are maintained in a hot standby state, while others are powered- off or set to operate in a low power mode. During times of high load, the servers in the hot standby state can be provisioned quickly into the application service.

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SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 03/04650

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06F9/50 G06F1/32

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 7 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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in 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 document but published on or after the international filing date

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"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	Date of mailing of the international search report
18 February 2005	03/03/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Fournier, N

Form PCT/ISA/210 (second sheet) (January 2004)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CHASE J S ET AL: "Managing energy and server resources in hosting centers" PROCEEDINGS OF THE ACM SYMPOSIUM ON OPERATING SYSTEMS PRINCIPLES, XX, XX, vol. 35, no. 5, 21 October 2001 (2001-10-21), pages 103-116, XP002261815	1-3,6,7, 9-11,13, 14
Y	abstract page 103, left-hand column, last paragraph - right-hand column, line 33 page 104, left-hand column, lines 1-15 page 104, left-hand column, lines 28-38 page 104, right-hand column, line 28 - page 105, right-hand column, last line page 106, right-hand column, lines 1-29 pages 110-111, paragraph 5.2 page 113, right-hand column, lines 16-26 page 114, right-hand column, lines 14-42 page 114, right-hand column, line 54 - page 115, left-hand column, last line	4,12
X	PINHEIRO E ET AL: "Load Balancing and Unbalancing for Power and Performance in Cluster-Based Systems" WORKSHOP ON COMPILERS AND OPERATING SYSTEMS FOR LOW POWER, COLP'01, 9 September 2001 (2001-09-09), XP002261813 abstract page (4-1), paragraph '1. Introduction! page (4-2), left-hand column, line 32-right-hand column, line 30 page (4-3), left-hand column, paragraph 'Load (re-)distribution! page (4-3), right-hand column, paragraph, paragraph 'Power-aware cluster-based network server! page (4-7) left-hand column, paragraph 'Clusters!	1-3,6,7, 9-11,13, 14
Y	E ELNOZAHY, M KISTLER, R RAJAMONY: "Energy-efficient server clusters" PROCEEDINGS OF THE WORKSHOP ON POWER-AWARE COMPUTING SYSTEMS, 2 February 2002 (2002-02-02), XP002311105 page 8, last paragraph	4,12

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	K APPLEBY, S FAKHOURI, L FONG, G GOLDSZMIDT, M KALANTAR, S KRISHNAKUMAR, D P PAZEL, J PERSHING, B ROCHWERGER: "Oceano-SLA Based Management of a Computing Utility" PROCEEDINGS OF THE IEEE-IFIP INTERNATIONAL SYMPOSIUM ON INTEGRATED NETWORK MANAGEMENT, 14 May 2001 (2001-05-14), pages 855-868, XP002310934 abstract page 855, paragraph '1. Introduction! page 858, paragraph '2.1. SLA Metrics! pages 860-861, paragraph '3. Resource Director! page 863, paragraph '4.2. Server Management! page 864, lines 10-18; figure 4 -----	1-4,6,7, 9-14
X	US 2002/004912 A1 (FUNG HENRY T) 10 January 2002 (2002-01-10) paragraphs '0074!, '0137!, '0162! - '0165!, '0184! - '0189!, '0253!, '0296! page 39, right-hand column, line 9 - page 40, left-hand column, line 1 page 41, right-hand column, lines 50-56 page 47, left-hand column, lines 37-57 paragraph '0331! page 48, right-hand column, lines 19-24 page 49, left-hand column, lines 17-50 claims 1,36,37 page 40, right-hand column, lines 30-32 page 40, right-hand column, line 48 - page 41, left-hand column, line 10 page 41, left-hand column, line 37 - right-hand column, line 9 page 41, right-hand column, lines 50-54 -----	1-3, 6-11,13, 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 03/04650

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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. [X] Claims Nos.: 5
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:
see FURTHER INFORMATION sheet PCT/ISA/210

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

see additional sheet

1. [X] 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 an additional fee, this Authority did not invite payment of any additional fee.

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.

[X] No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7,9-14

(i) monitoring the workload on a server cluster, allocating servers to applications, and adapting the power state of the servers according to said workload and topology
(ii) dividing the set of servers into three distinct subsets: the active servers; the hot standby servers that are idle but ready to become active; and the servers that are powered down. Servers can be dynamically realocated between those three sets, as needed, albeit the transitions take different lengths of time.

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2. claim: 8

(i) monitoring the workload on a server cluster, allocating servers to applications, and adapting the power state of the servers according to said workload and topology
(iii) dedicating sub-sets of servers to specific applications and providing distinct power management policies for each sub-set.

Continuation of Box I.2

Claims Nos.: 5

The additional subject-matter of claim 5 is directed towards "determining a workload indicative of the elapsed time since the one server was last reset".
However, the description does not disclose how the workload could be determined with some relation to the time when the server was reset, and it is not obvious to the person of the art how this subject-matter could be realised.
The only passage refering to reseting the computer is related to determining the topology of the application service (description, page 9, lines 24-27), which is not related to determining the workload of servers in the cluster. The mere repetition of claim 5 in the description (page 3, lines 26-28) does not further clarify how the claimed subject-matter could be realised.

The subject-matter of claim 5 is therefore not sufficiently supported by the description and therefore unclear, contrary to the requirements of Articles 5 and 6 PCT.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 03/04650

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002004912 A1	10-01-2002	US 6079025 A	20-06-2000
		US 5892959 A	06-04-1999
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		US 6584571 B1	24-06-2003
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		US 2002062454 A1	23-05-2002