US006148324A

United States Patent [19]

Ransom et al.

[11] **Patent Number: 6,148,324**

[45] **Date of Patent: Nov. 14, 2000**

[54] **PRIORITIZED LOAD BALANCING AMONG NON-COMMUNICATING PROCESSES IN A TIME-SHARING SYSTEM**

[75] Inventors: **Antonio Juan Ransom**, Bolingbrook; **Dennis James Wiest**, Naperville, both of Ill.

[73] Assignee: **Lucent Technologies, Inc.**, Murray Hill, N.J.

[21] Appl. No.: **09/002,982**

[22] Filed: **Jan. 5, 1998**

[51] **Int. Cl.**[7] **G06F 9/00**

[52] **U.S. Cl.** **709/105**; 709/103

[58] **Field of Search** 709/102, 103, 709/104, 105

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,481,583	11/1984	Muller	709/104
5,309,501	5/1994	Kozik et al. .	
5,519,867	5/1996	Moeller et al. .	
5,530,860	6/1996	Matsuura	709/105
5,550,898	8/1996	Abbasi et al. .	
5,615,249	3/1997	Solondz .	
5,652,885	7/1997	Reed et al. .	
5,655,120	8/1997	Witte et al. .	
5,845,116	12/1998	Saito et al.	709/103

OTHER PUBLICATIONS

Armand et al., "Muti–threaded Processes in Chorus/Mix", Chorus Systemes, Apr. 1990—pp. 1–15.

Stevens, "UNIX Network Programming", 1990 Prentice Hall P T R—pp. 72–75.

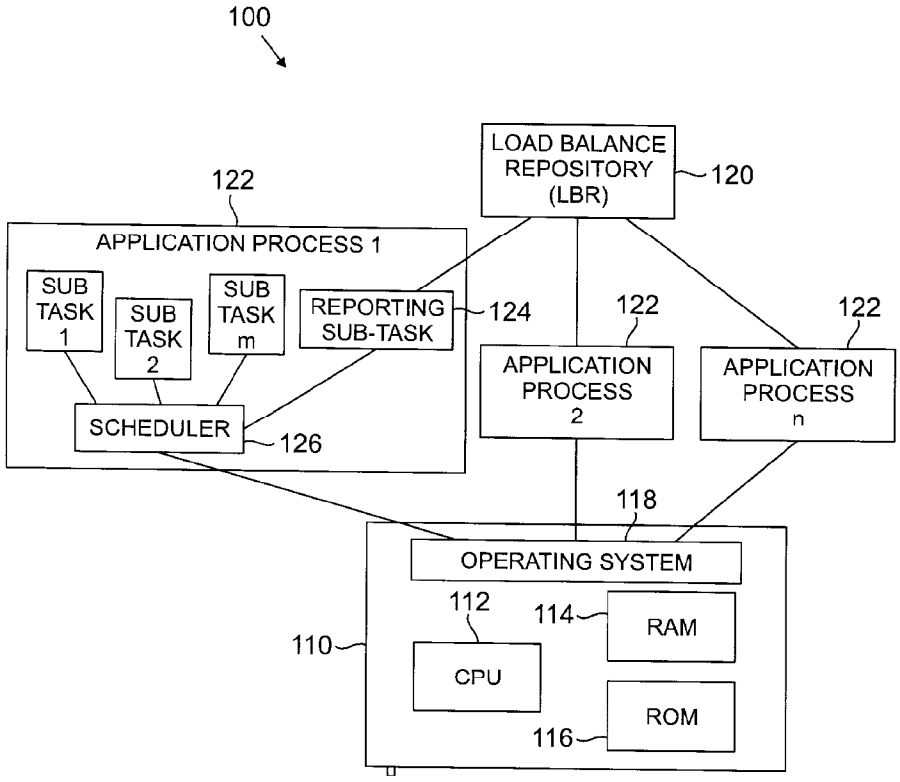
Primary Examiner—Alvin E. Oberley

Assistant Examiner—Van Nguyen

[57] **ABSTRACT**

A method and apparatus for prioritized load-balancing among non-communicating processes in a time-sharing system involves a Load Balancing Repository (LBR) which interfaces with each process that is actively addressed by the CPU. A scheduler within each process provides the LBR with a load distribution for that process representing the ratio of high-priority sub-task load to low-priority sub-task load. The LBR determines a target ratio in the form of an aggregate load distribution ratio. The target ratio is reported back to each active process. For processes which are occupied with a relatively low proportion of high priority sub-tasks and which therefore exhibit a load distribution that is below the target ratio, the process scheduler will give up a portion of the time slice allotted to that process by the operating system when the load distribution of that process reaches the target ratio. Thus, CPU resources will be applied more frequently to processes which are occupied with a relatively high proportion of high priority sub-tasks.

17 Claims, 5 Drawing Sheets



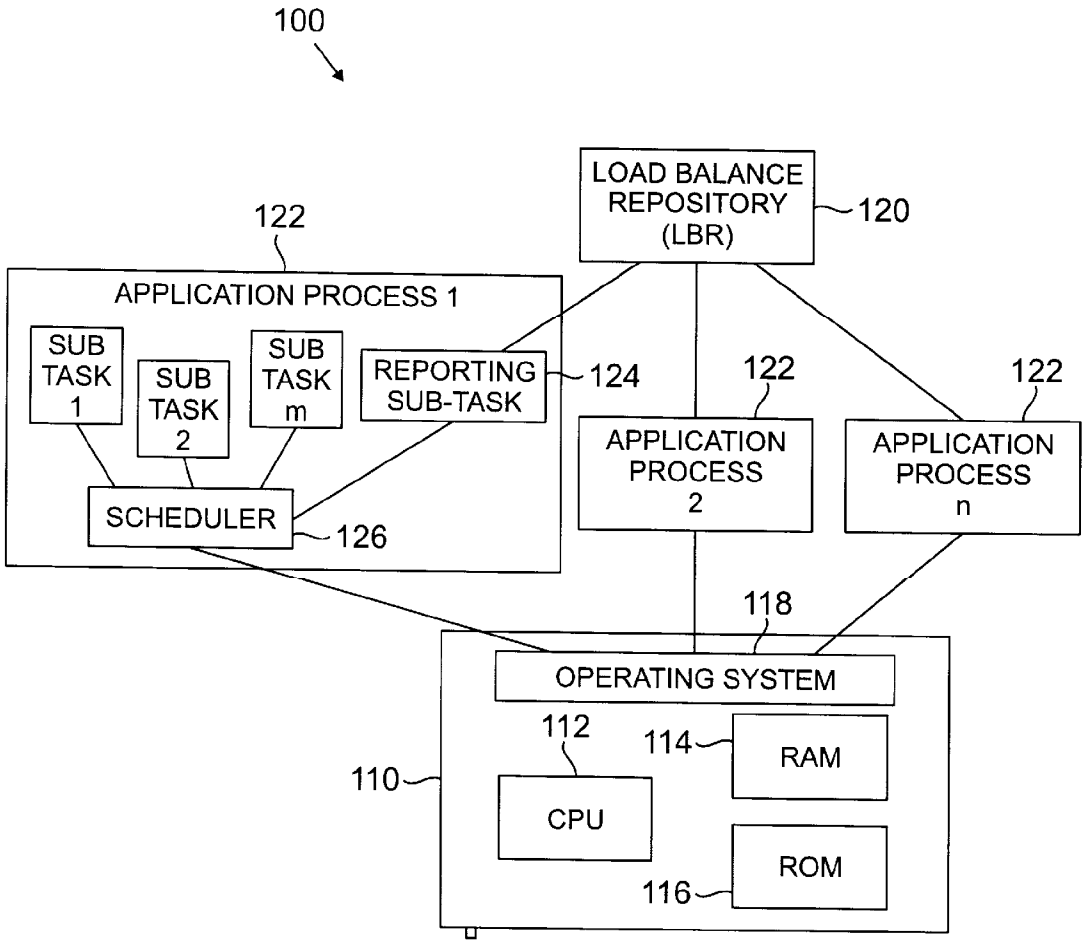


FIG. 1

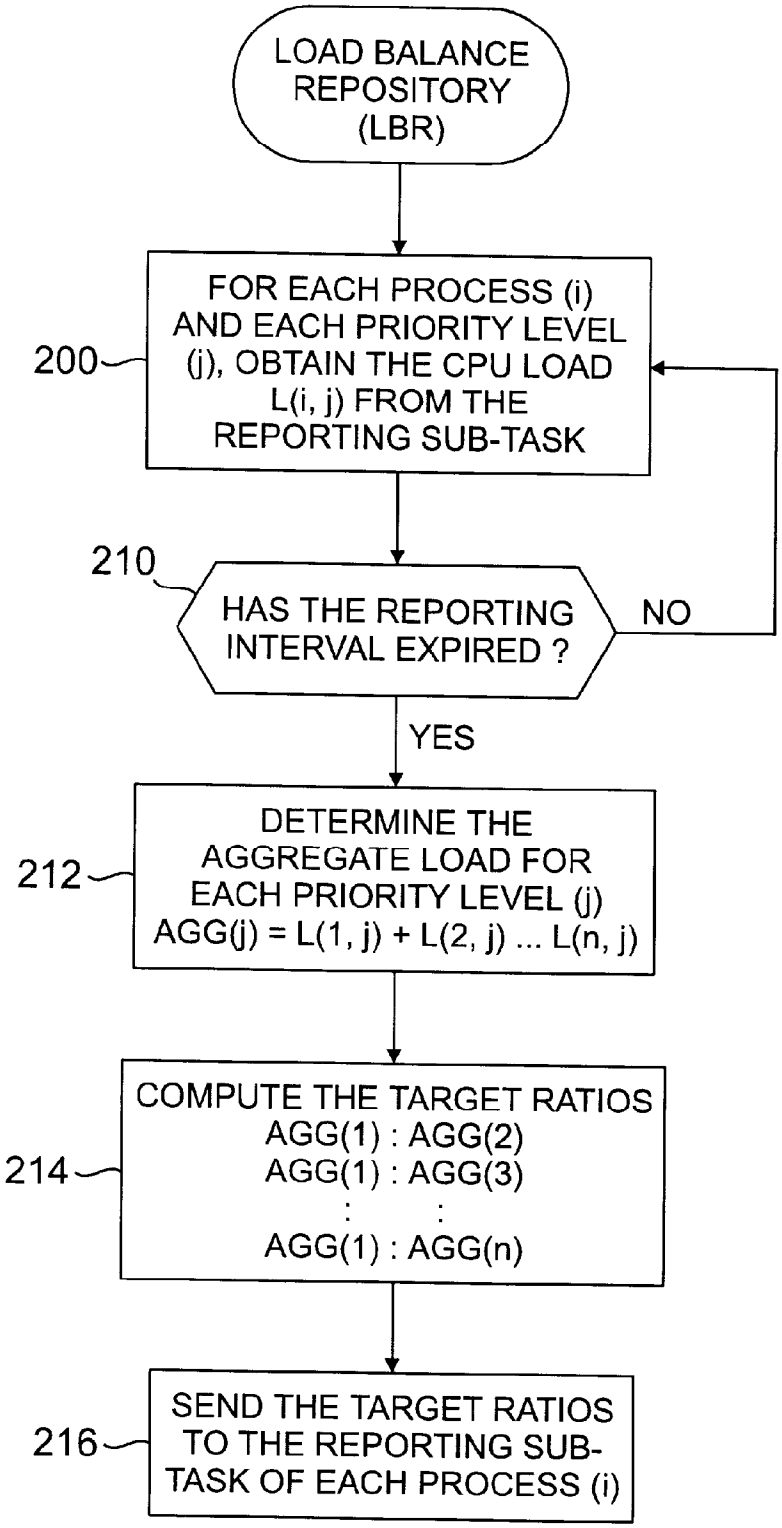


FIG. 2

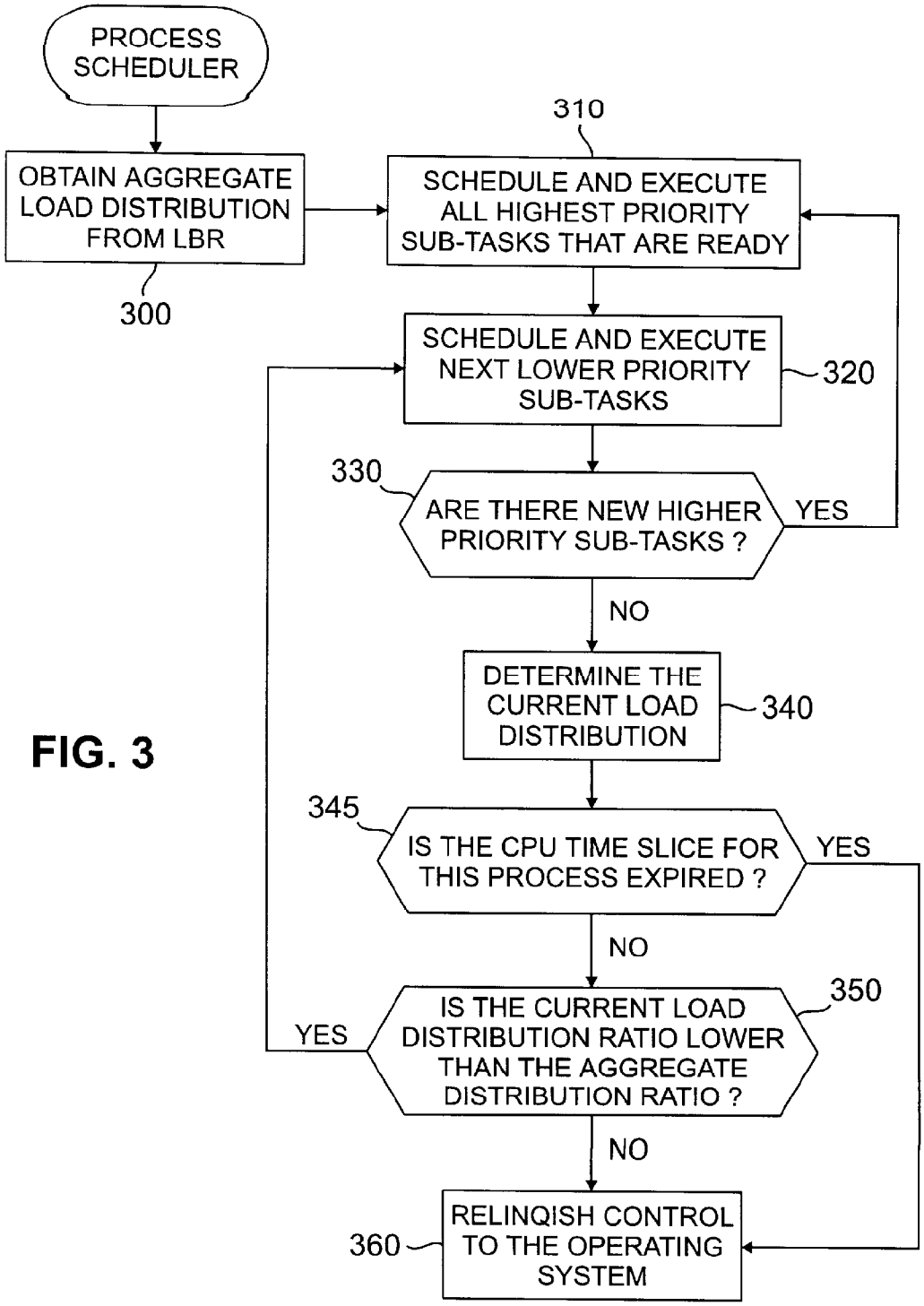


FIG. 3

CPU LOAD DISTRIBUTION AT INITIAL LBR REPORTING INTERVAL

	CPU LOAD ATTRIBUTABLE TO HIGHEST PRIORITY SUB-TASKS (PRIORITY LEVEL 1)	CPU LOAD ATTRIBUTABLE TO LOWER PRIORITY SUB-TASKS (PRIORITY LEVEL 2)	TOTAL CPU LOAD ATTRIBUTABLE TO PROCESS
PROCESS 1	$L_{1,1}$ = 20 ms	$L_{1,2}$ = 80 ms	100 ms
PROCESS 2	$L_{2,1}$ = 40 ms	$L_{2,2}$ = 60 ms	100 ms
PROCESS 3	$L_{3,1}$ = 60 ms	$L_{3,2}$ = 40 ms	100 ms
AGGREGATE	AGG_1 = 120 ms	AGG_2 = 180 ms	

AGGREGATE LOAD DISTRIBUTION RATIO = AGG_1:AGG_2 = 120:180 = 2:3

FIG. 4A

CPU LOAD DISTRIBUTION AT SECOND LBR REPORTING INTERVAL

	CPU LOAD ATTRIBUTABLE TO HIGHEST PRIORITY SUB-TASKS (PRIORITY LEVEL 1)	CPU LOAD ATTRIBUTABLE TO LOWER PRIORITY SUB-TASKS (PRIORITY LEVEL 2)	TOTAL CPU LOAD ATTRIBUTABLE TO PROCESS
PROCESS 1	$L_{1,1}$ = 20 ms	$L_{1,2}$ = 30 ms	50 ms
PROCESS 2	$L_{2,1}$ = 40 ms	$L_{2,2}$ = 60 ms	100 ms
PROCESS 3	$L_{3,1}$ = 60 ms	$L_{3,2}$ = 40 ms	100 ms
AGGREGATE	AGG_1 = 120 ms	AGG_2 = 130 ms	

AGGREGATE LOAD DISTRIBUTION RATIO = AGG_1:AGG_2 = 120:130

FIG. 4B

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.