



US008271812B2

(12) **United States Patent**
de Cesare et al.

(10) **Patent No.:** **US 8,271,812 B2**
(45) **Date of Patent:** **Sep. 18, 2012**

(54) **HARDWARE AUTOMATIC PERFORMANCE STATE TRANSITIONS IN SYSTEM ON PROCESSOR SLEEP AND WAKE EVENTS**

6,510,525 B1 * 1/2003 Nookala et al. 713/324
6,535,798 B1 3/2003 Bhatia et al.
6,665,802 B1 * 12/2003 Ober 713/320
6,823,516 B1 11/2004 Cooper

(75) Inventors: **Josh P. de Cesare**, Campbell, CA (US);
Jung Wook Cho, Cupertino, CA (US);
Toshi Takayanagi, San Jose, CA (US);
Timothy J. Millet, Mountain View, CA (US)

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0855718 7/1998
(Continued)

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

OTHER PUBLICATIONS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 262 days.

Combined Search and Examination Report in Application No. GB1105852.6 issued Aug. 1, 2011.

(Continued)

(21) Appl. No.: **12/756,006**

(22) Filed: **Apr. 7, 2010**

Primary Examiner — Stefan Stoynov

(65) **Prior Publication Data**

US 2011/0252251 A1 Oct. 13, 2011

(74) *Attorney, Agent, or Firm* — Lawrence J. Merkel; Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C.

(51) **Int. Cl.**

G06F 1/00 (2006.01)
G06F 1/26 (2006.01)
G06F 3/038 (2006.01)
G06F 3/00 (2006.01)
G09G 3/18 (2006.01)
G11C 5/14 (2006.01)
H04M 1/00 (2006.01)

(57) **ABSTRACT**

In an embodiment, a power management unit (PMU) may automatically transition (in hardware) the performance states of one or more performance domains in a system. The target performance states to which the performance domains are to transition may be programmable in the PMU by software, and software may signal the PMU that a processor in the system is to enter the sleep state. The PMU may control the transition of the performance domains to the target performance states, and may cause the processor to enter the sleep state. In an embodiment, the PMU may be programmable with a second set of target performance states to which the performance domains are to transition when the processor exits the sleep state. The PMU may control the transition of the performance domains to the second targeted performance states and cause the processor to exit the sleep state.

(52) **U.S. Cl.** **713/300**; 713/320; 713/323; 713/324; 345/52; 345/211; 365/227; 455/574; 719/321

(58) **Field of Classification Search** 713/300, 713/320, 323, 324; 345/52, 211; 365/227; 455/574; 719/321

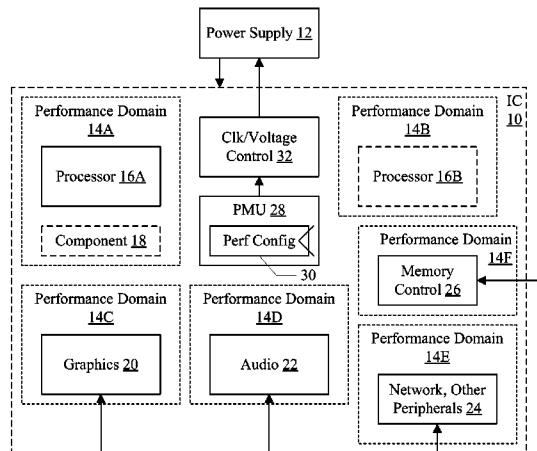
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,813,022 A 9/1998 Ramsey
6,128,747 A * 10/2000 Thoulon 713/330

11 Claims, 5 Drawing Sheets



US 8,271,812 B2

Page 2

U.S. PATENT DOCUMENTS

7,369,815 B2* 5/2008 Kang et al. 455/73
7,590,473 B2 9/2009 Wyatt
2003/0061383 A1 3/2003 Zilka
2005/0064829 A1* 3/2005 Kang et al. 455/127.1
2006/0259800 A1* 11/2006 Maejima 713/300
2007/0150759 A1 6/2007 Srinivasan et al.
2007/0234078 A1 10/2007 Nguyen
2008/0168285 A1 7/2008 de Cesare et al.
2008/0307245 A1 12/2008 de Cesare et al.
2009/0063715 A1 3/2009 de Cesare et al.
2009/0204837 A1 8/2009 Raval

2010/0211700 A1 8/2010 de Cesare et al.

FOREIGN PATENT DOCUMENTS

GB 2472050 1/2011

OTHER PUBLICATIONS

International Search Report and Written Opinion from PCT/US
11/31358, mailed Jun. 13, 2011, Apple Inc., 12 pages.

* cited by examiner

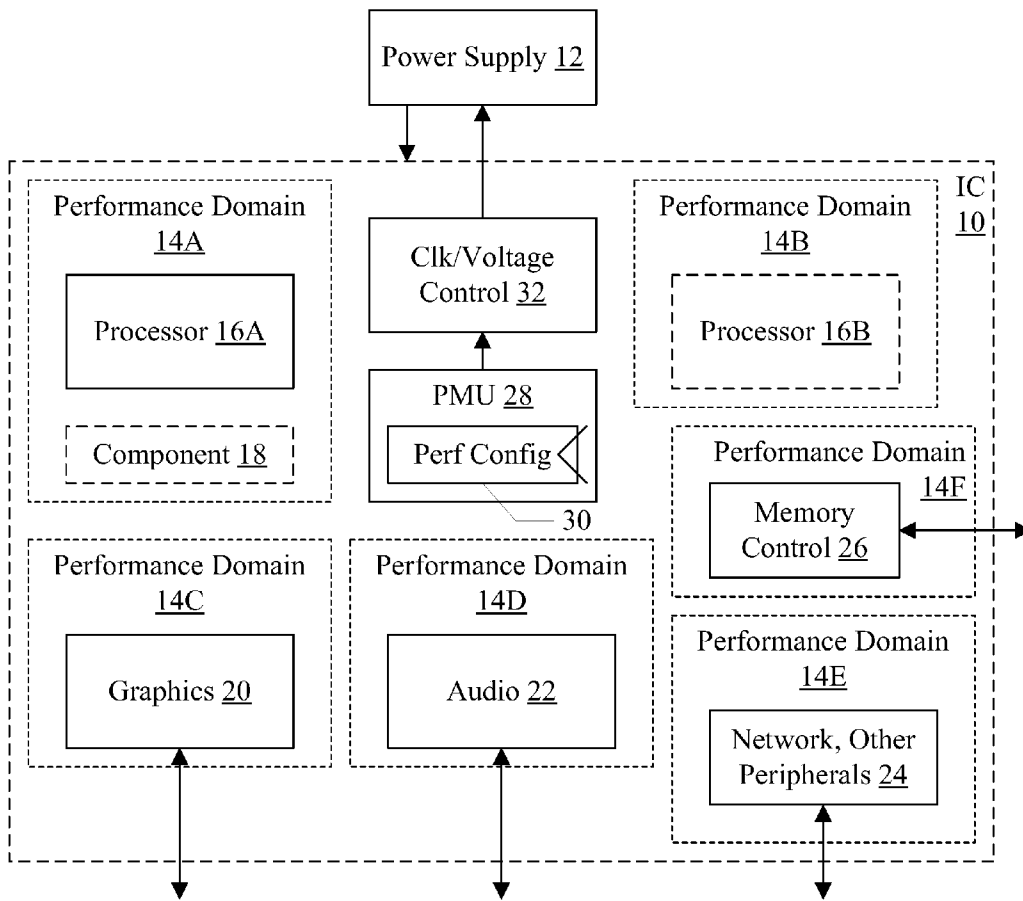


Fig. 1

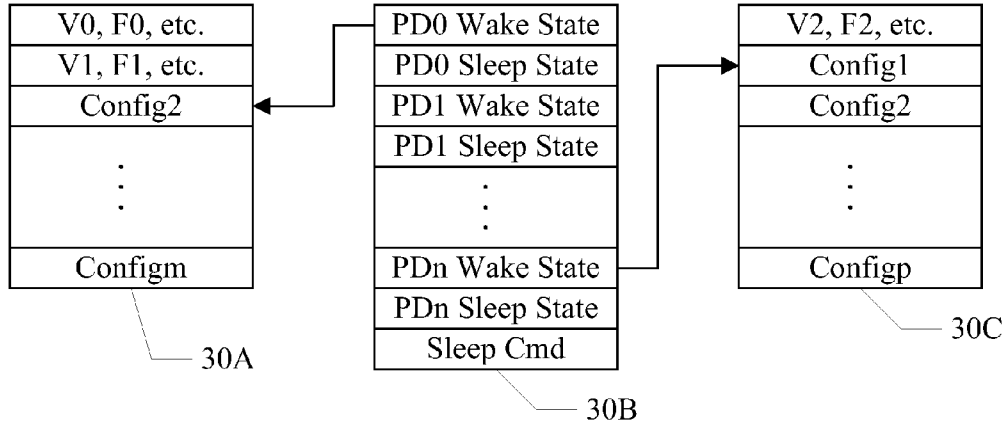


Fig. 2

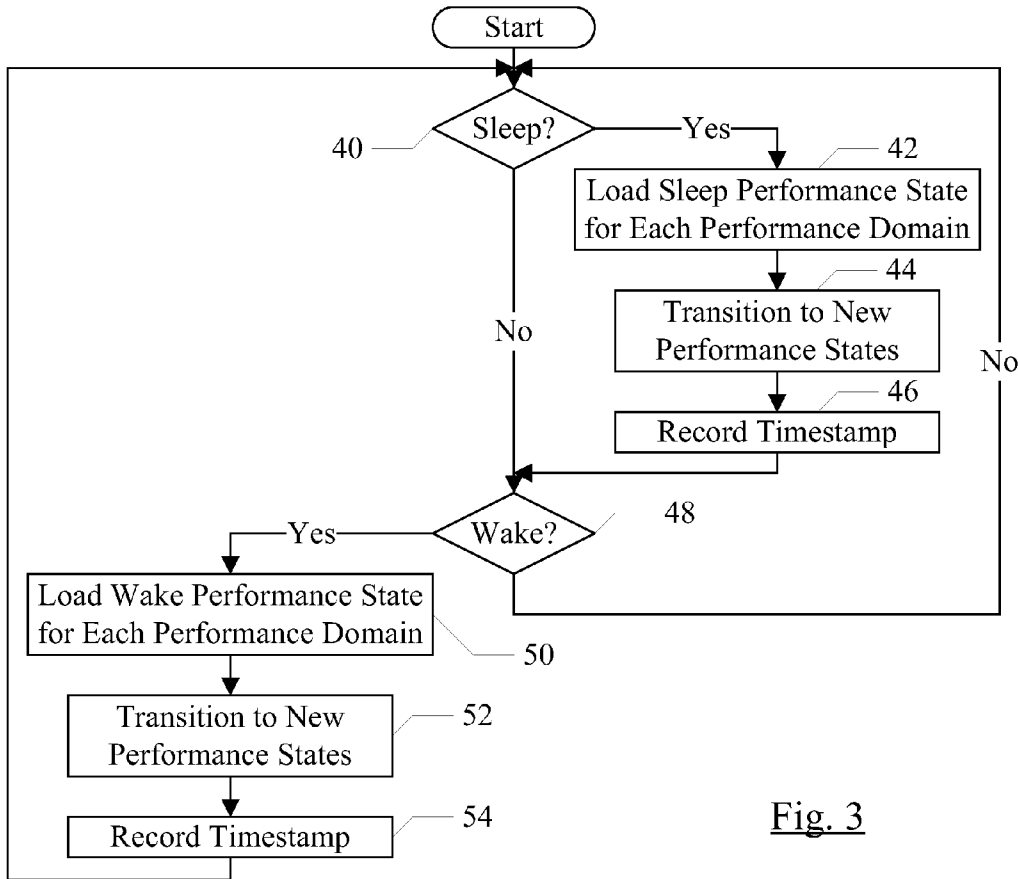


Fig. 3

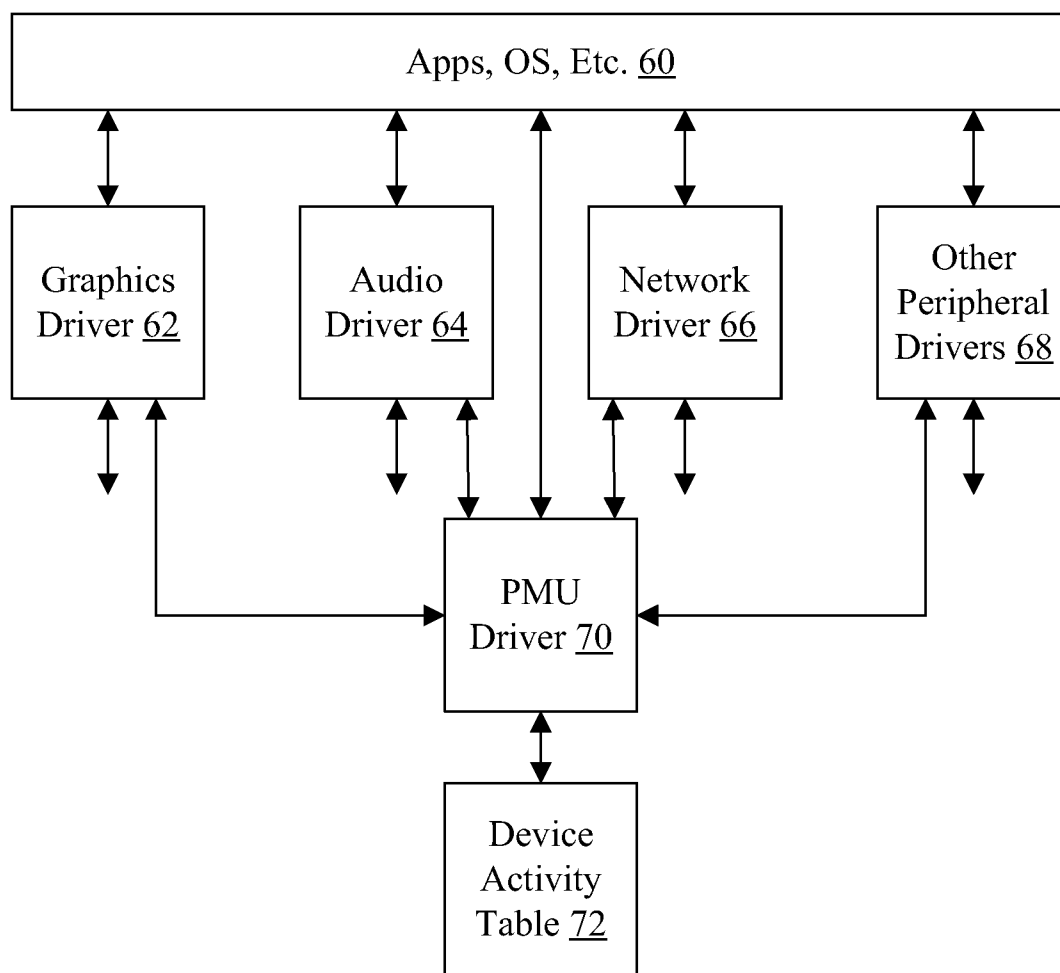


Fig. 4

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.