Advanced Configuration and Power Interface (ACPI)

ACPI

- Advanced Configuration and Power Interface
  - Conceived by Intel, Microsoft, and Toshiba (the promoters)
- An “interface” specification
  - ACPI/OSPM replaces APM, MPS, and PnP BIOS Spec
- Allow OS-directed Power Management (OSPM)
- Defines
  - Hardware registers - implemented in chipset silicon
  - BIOS interfaces
    - Configuration tables
    - Interpreted executable function interface (Control Methods)
    - Motherboard device enumeration and configuration
  - System and device power states
  - ACPI Thermal Model

[INTEL]

ACPI State Definitions

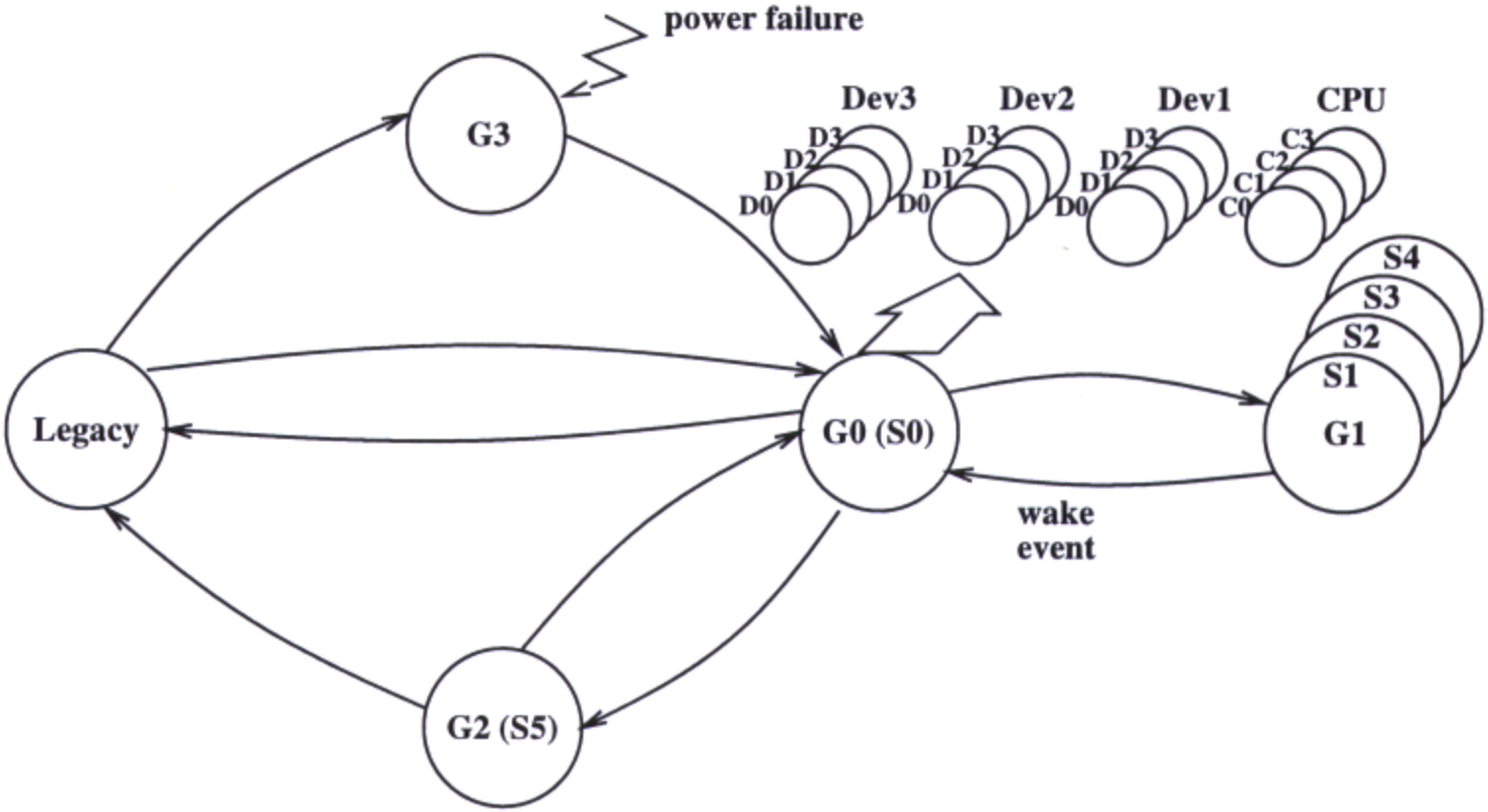


Figure 6.8. Global and power states and substates

ACPI States Definitions

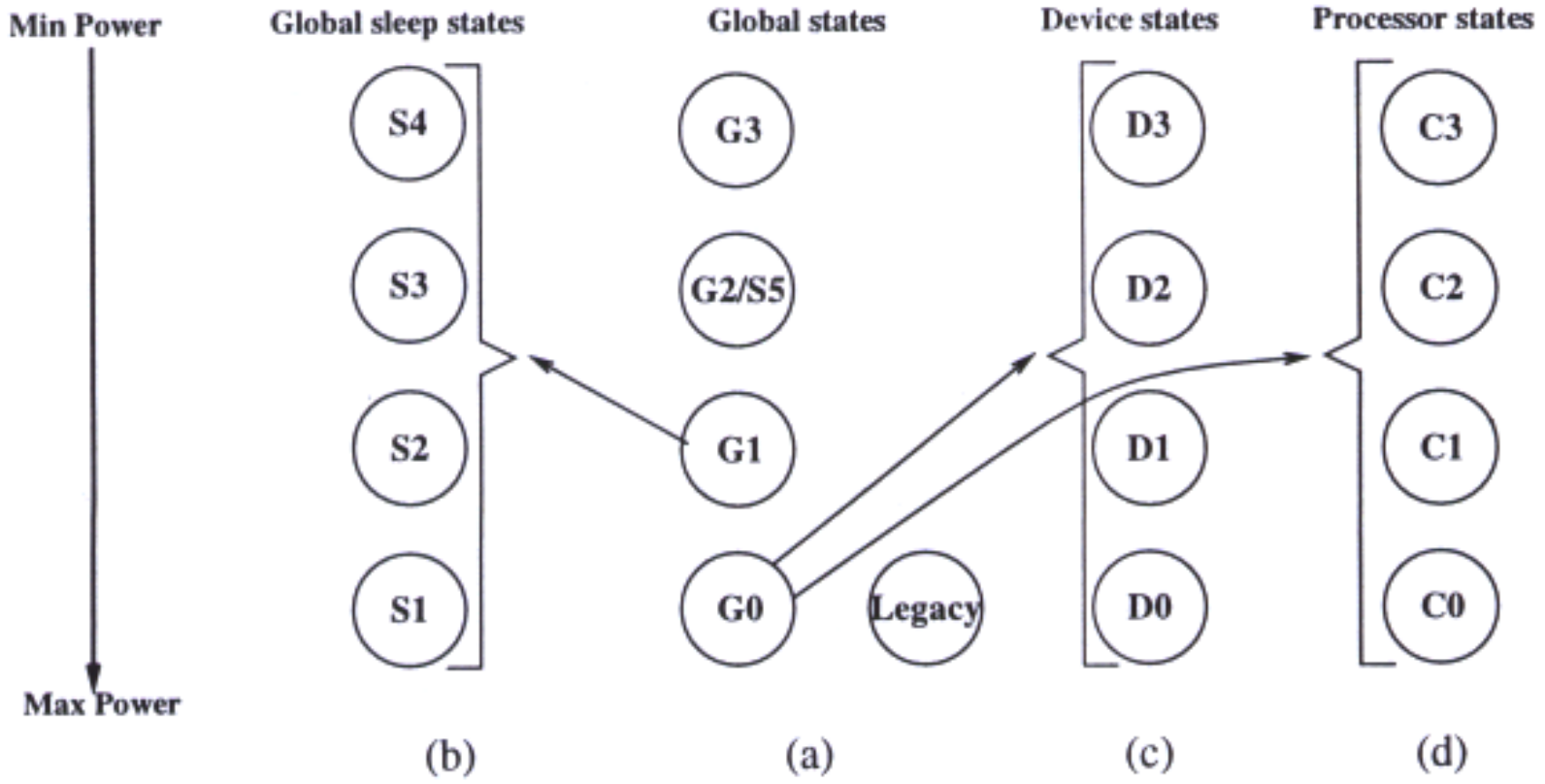


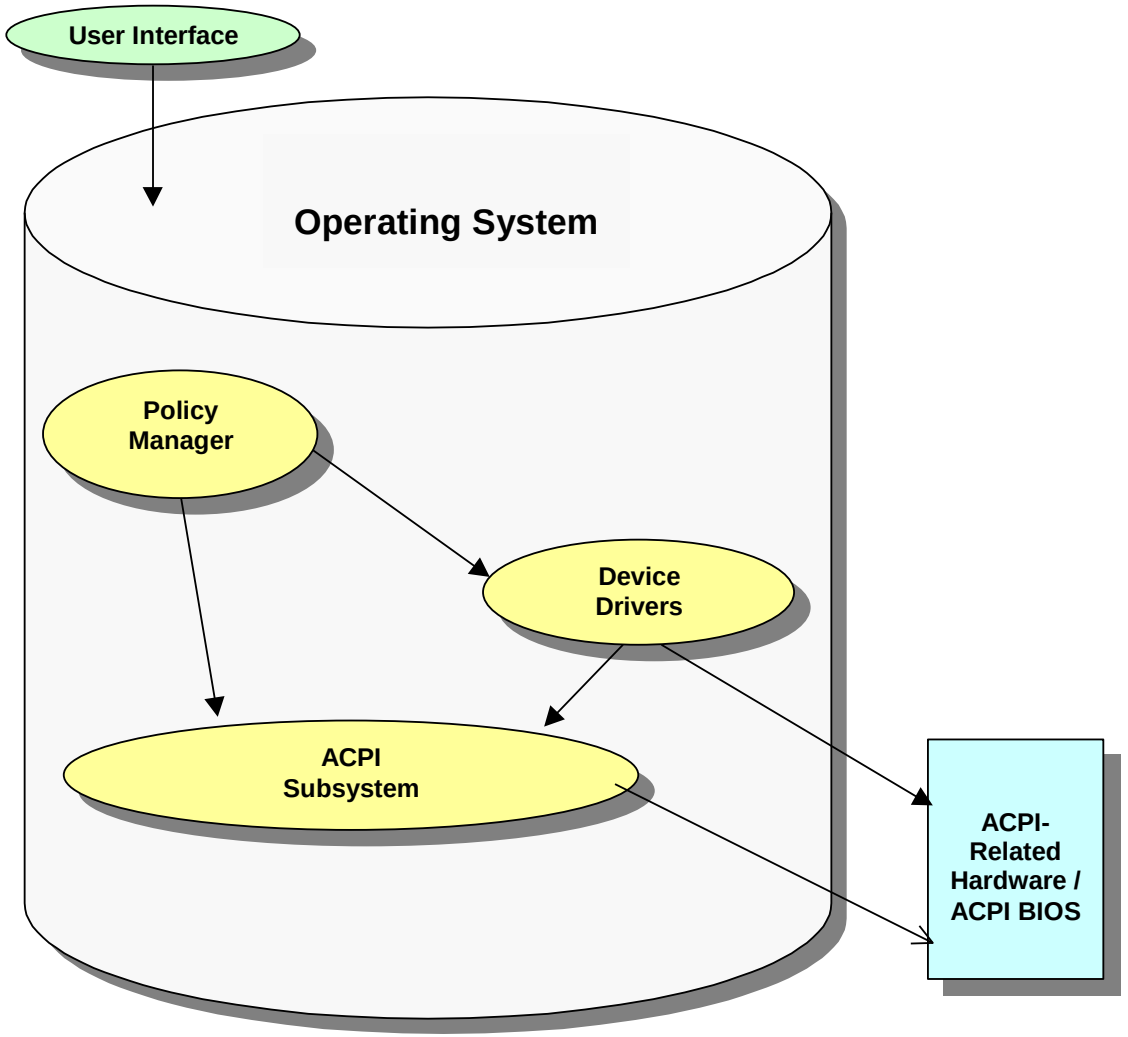
Figure 6.7. State definitions for ACPI

ACPI States

[www.wikipedia.com]

- **Global States:**
  - **G0 (S0) (Working), G1(Sleeping), G2 (S5) (Soft Off), G3 (Mechanical Off)**
- **Sleep States:**
  - **S1: sleeping with processor context & RAM maintained**
  - **S4: RAM not maintained, most devices in D3**
- **Device States:**
  - **D0: fully-on**
  - **D1 and D2: intermediate power-states**
  - **D3: power off**
- **CPU States:**
  - **C0, C1 (Halt), C2 (Stop-Clock), C3 (Sleep)**
- **Performance States: in D0 or C0**
  - **P0 (max power and freq)**
  - **Pn less than P(n-1), voltage/freq scaled**

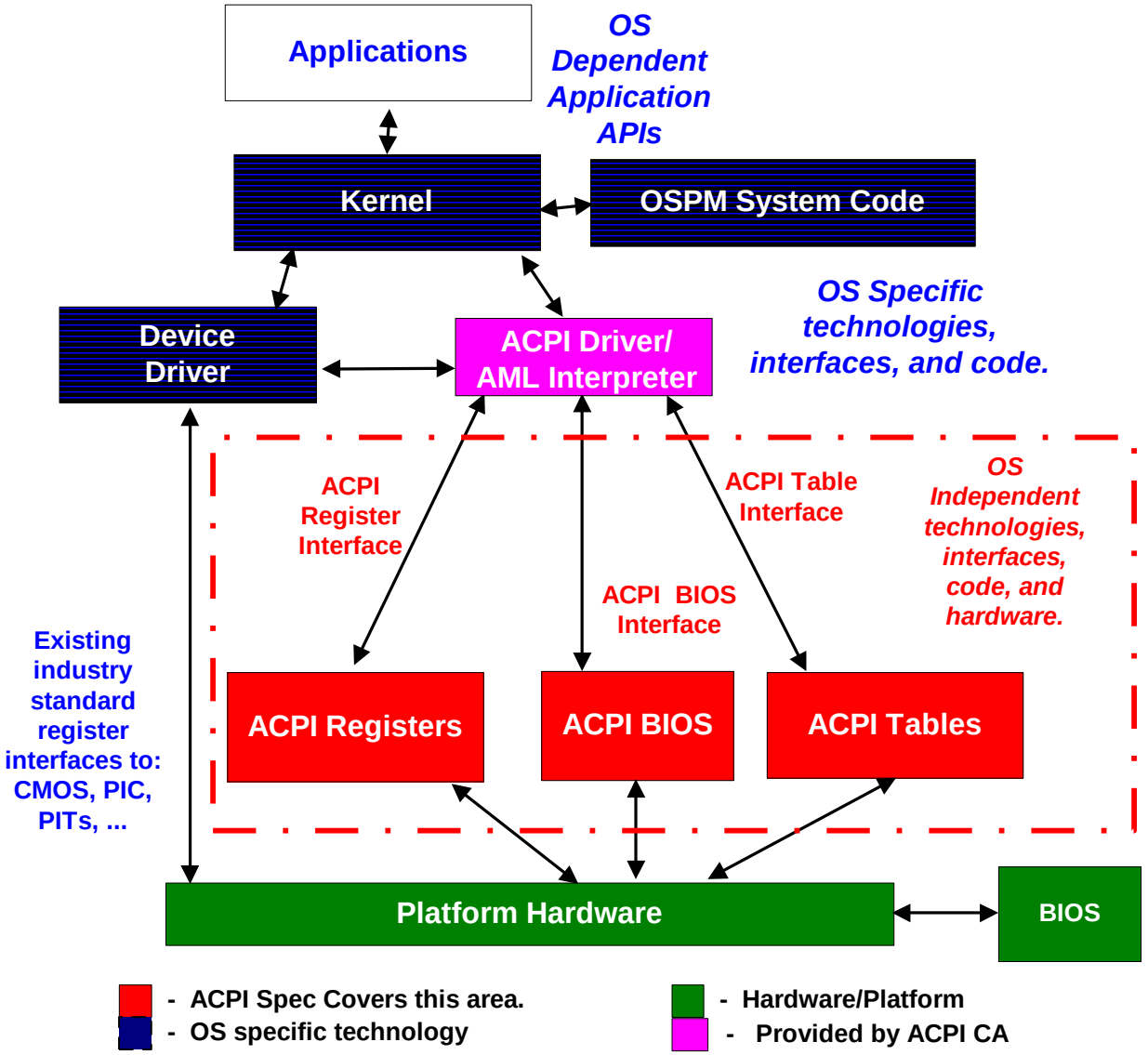
An ACPI System



ACPI Software Components

- ACPI Subsystem
  - Consumes ACPI BIOS
  - Interacts with ACPI Hardware
- Policy Manager (OSPM)
  - Sets and Monitors System Policies
  - User Interface
    - Allows User Input to Policy
- Device Drivers
  - EC, SM Bus, CM Battery, Smart Battery

ACPI System Overview



ACPI Interface & PC Platform

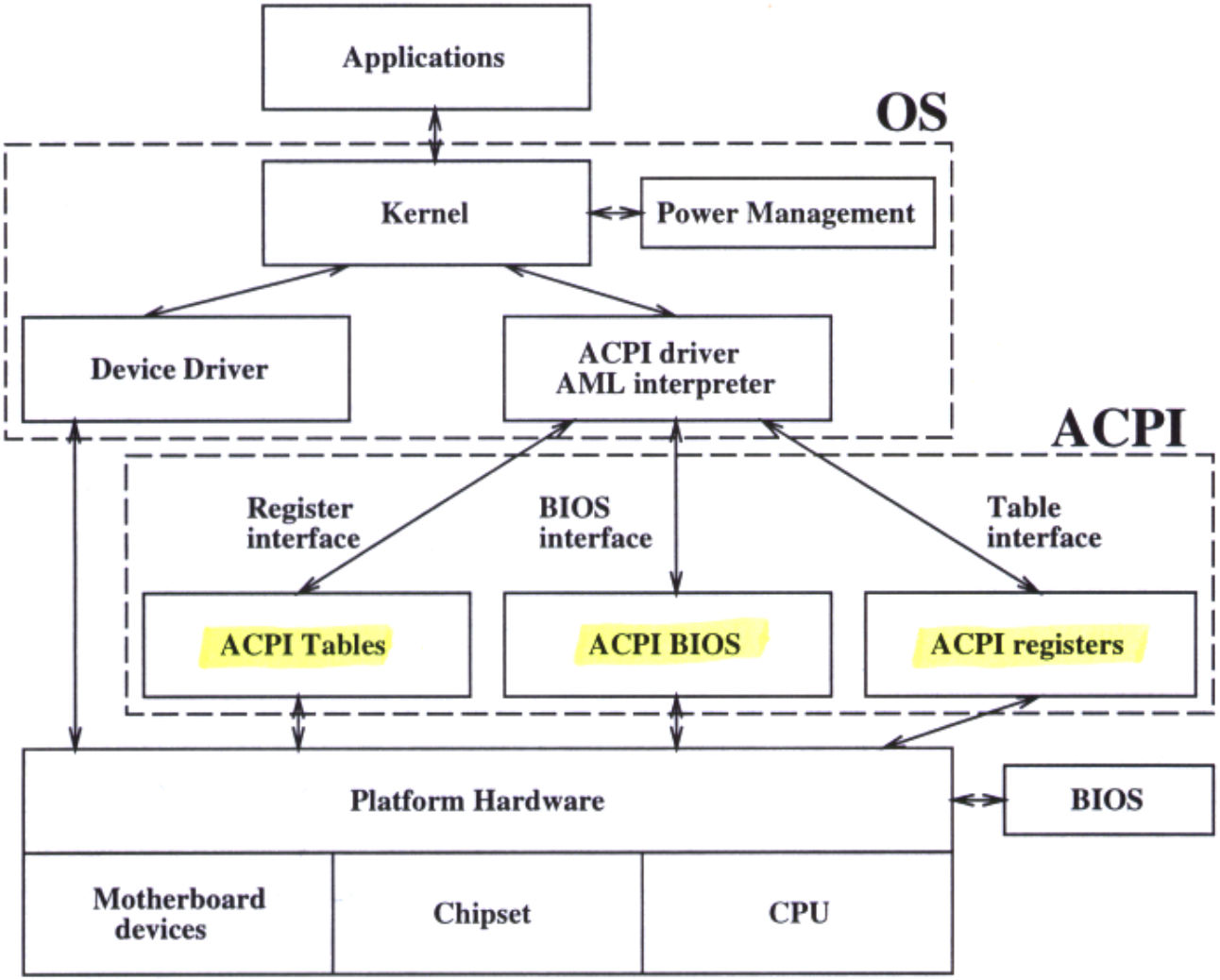


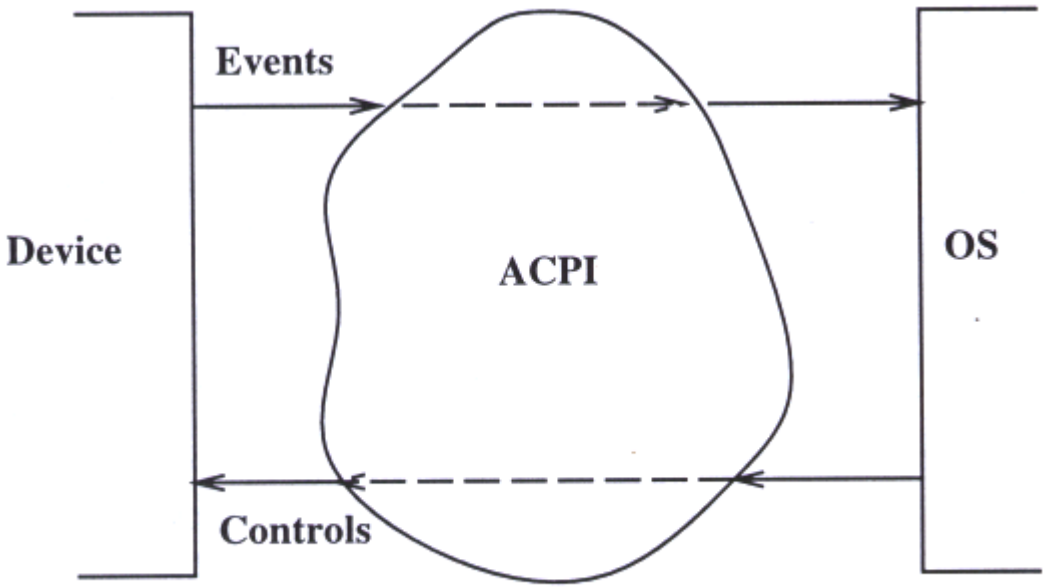
Figure 6.6. ACPI interface and PC platform

ACPI Components

- ACPI DOES NOT specify how to implement hardware devices or the power management policy in OS.

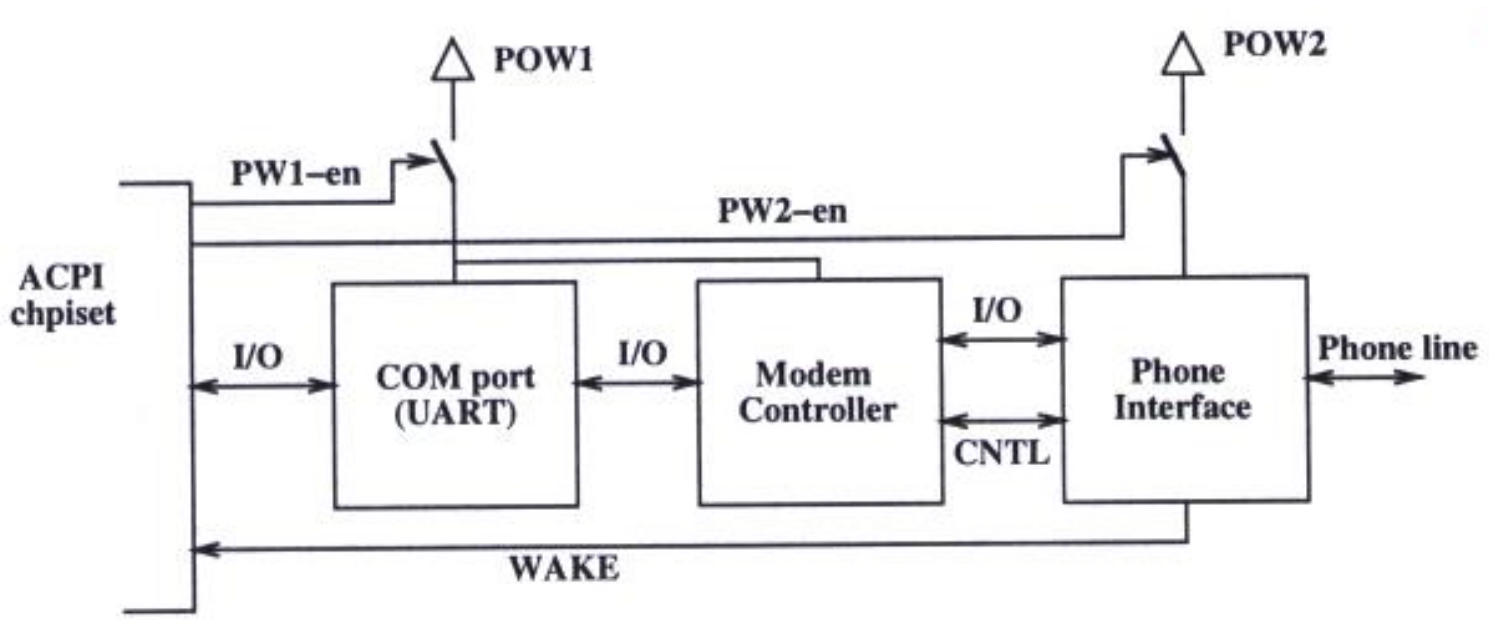
- ACPI Tables
  - Interface to hardware
- ACPI BIOS
  - Portion of firmware compatible with ACPI
- ACPI Registers
  - Constrained part of the hardware interface

Device Power Management



- Identification of device power capabilities
- Setting device power states
- Getting device power states
- Enabling device-controlled wakeup

Example: Integrated Modem



- D0
- D1: MC & phone interface in low-power mode
- D2:
- D3: MC is off, phone interface powered by phone line or off

Battery Management

- Must confirm either Smart Battery subsystem interface or a control method battery (CMBatt) interface

- CMBatt reports
  - The designed capacity
  - The latest full-charged capacity
  - The current remaining capacity
  - Warning, Low & Critical status messages

Thermal Management

- Based on thermal zones
  - Using temperature events
- Two types of cooling
  - Active cooling
    - Exploits cooling devices (e.g., fans)
    - Increases power to reduce heat
  - Passive cooling
    - Reduces the power-consuming activities
    - Reduces power to decrease temperature

Example: Thermal Zones

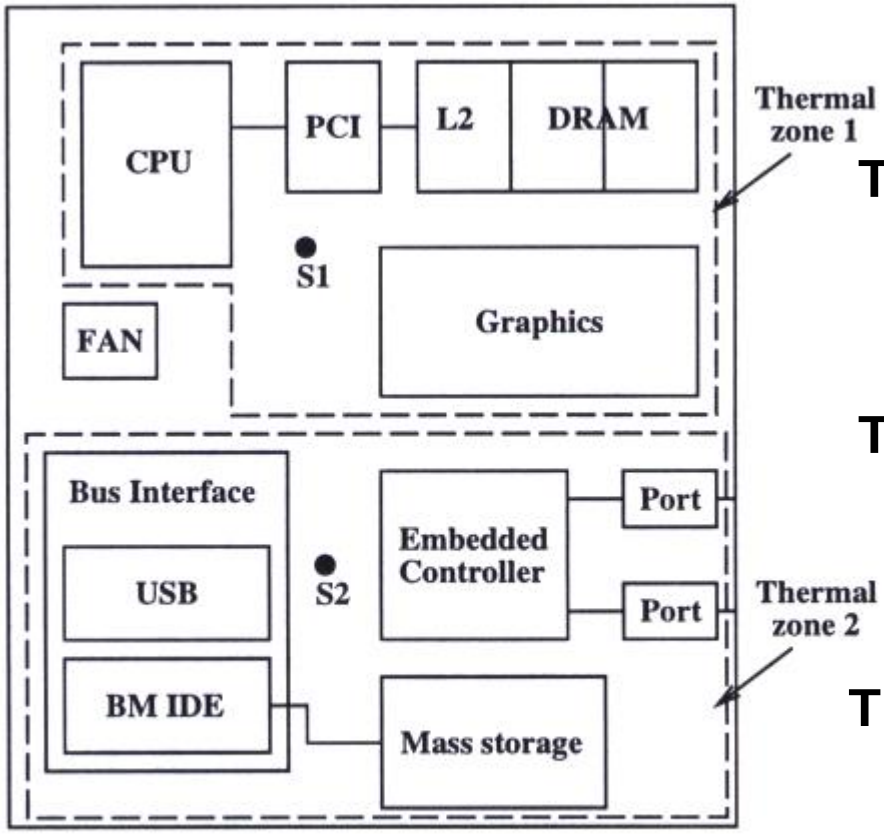


Figure 6.11. Thermal zones in a PC board

To = 50°C

passive cooling activated
CPU clock slowed down by 2

T1 = 70°C

active cooling activated
fan is started

T = 60°C, fan is started