ACPI

Advanced Configuration and Power Interface

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28/11/2000

ACPI - Advanced Configuration and Power Interface

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What is ACPI ?

- stands for Advanced Configuration and Power Interface Specification (Last release 2.0)
- key element in Operating System directed Power Management (OSPM)
  - enumerate and configure system devices
  - manage their power
- evolves power management BIOS code
  - APM APIs (Advanced Power Management)
  - PNPBIOS APIs (Plug and Play BIOS)
- evolves system configuration interfaces

Why ACPI ?

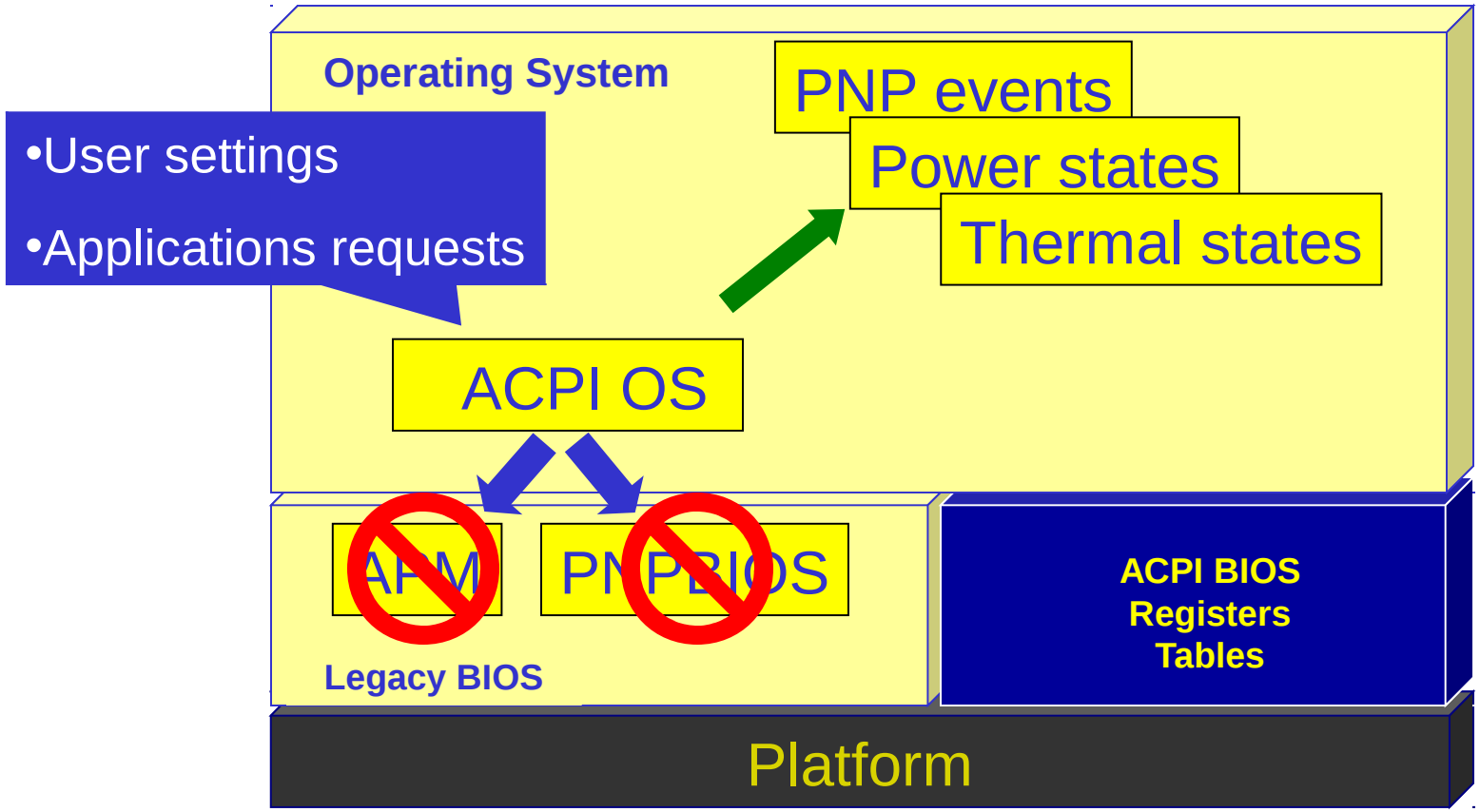
- BIOS controlled power management without the knowledge of the operating system
- three major flaws with APM
  - Power management policy had to be re-implemented for each platform
  - BIOS had an incomplete picture of the platform's actual usage
  - BIOS didn't have enough room to implement a sophisticated power policy
- PNPBIOS could be unreliable, earning it the nickname "Plug and Pray"

Principal Goals of ACPI

- by moving the power management responsibility to the operating system, ACPI
  - enhances power management functionality and robustness
  - enables better power management decisions
- facilitate and accelerate industry implementation of power management
  - reduce the amount of redundant investment
  - OS can evolve separately from the hardware
  - unification of power management algorithms
- create a robust interface for configuring system devices

Operating System directed Power Management

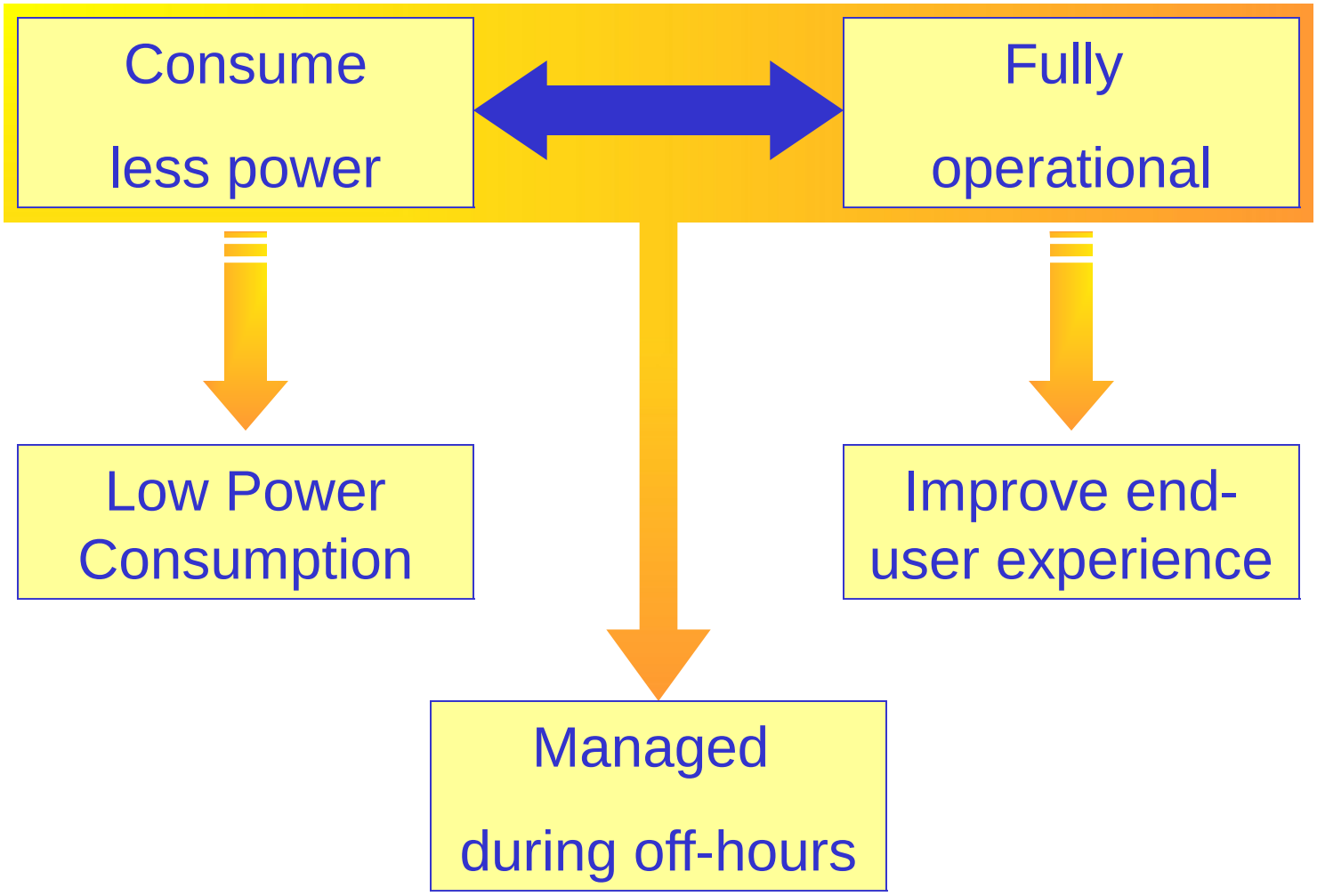
- ACPI gives OS direct and exclusive control over the power management and plug and play functions of your computer.



Functional areas covered by the ACPI

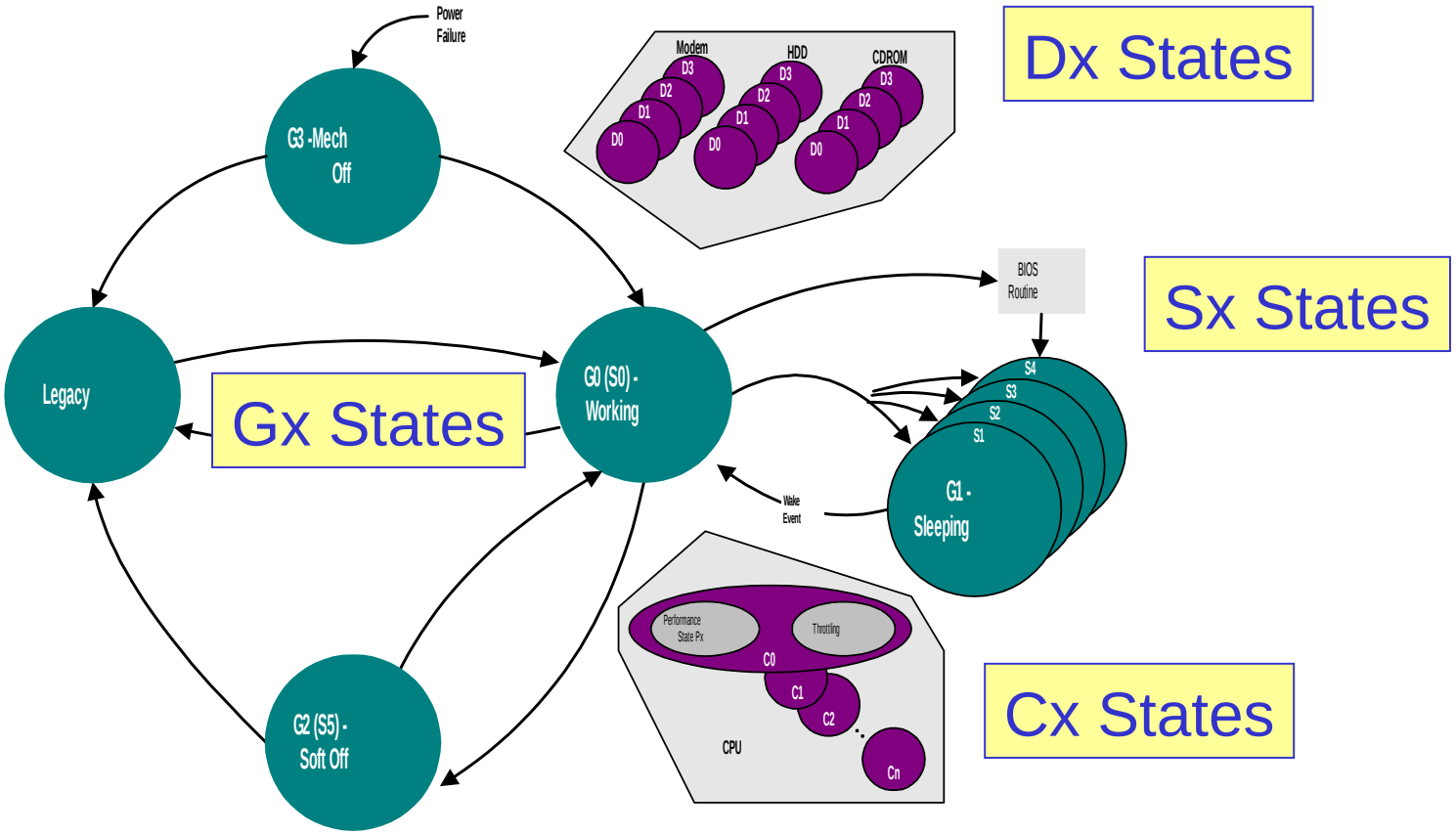
- Power Management
- Plug and Play
- System Events
- Battery Management
- Thermal Management
- Embedded Controller
- System Management Bus Controller

Focus on Power Management



Focus on Power Management

- OS uses ACPI to control power state transition
- Power states from a user-visible level:



Global Power States Definitions

- Gx States apply to entire system and are visible to the user

Global system state	Soft runs	Latency	Power consumption	OS restart required	Safe to disassemble computer	Exit state electronically
G0 Working	✓	0	Large			✓
G1 Sleeping		>0	Smaller			✓
G2 Soft Off		Long	near 0	✓		✓
G3 Mechanical Off		Long	RTC battery	✓	✓	

Device Power State Definitions

- States of particular devices, generally not visible to the user

Device State	Power Consumption	Device Context Retained	Driver Restoration
D0 Fully-On	As needed for operation	All	None
D1	D0>D1>D2	>D2	<D2
D2	D1>D2>D3	<D1	>D1
D3 Off	0	None	Full initialization and load

Processor Power State Definitions

- Power consumption and thermal management states within the global working state G0.

Processor State	Executes Instructions	Power consumption	Latency	Cache context retained
C0	✓	As needed for operation	0	✓
C1		C1<C0	Lowest	✓
C2		C2<C1<C0	Long	✓
C3		C3<C2<C1<C0	Long	✓

Performance State Definitions

- Performance States are power consumption and capability states within the active/executing states, C0 and D0.

Performance state	Processor or device consumption	Processor or device performance
P0	Maximum	Maximum
P1	<Maximum	<Maximum
P*n* *n*<16	Minimum level but active	Minimum

New in ACPI 2.0

Sleeping States Definitions

- Types of sleeping states within the global sleeping state G1.

Sleeping state	**Windows interface**	**Power Consumption**	Latency	Context Retained	System Restoration after Wake event
S1	**Standby**	**Low (<50 watts)**	**low**	**All**	
S2	-	S2<S1	Low	CPU and cache lost	CPU start at reset vector
S3	Standby	S3<S2<S1 (<15 watts)	low	Context saved in RAM	Hardware restores CPU, cache and chipset
S4	Hybernate	Minimum (<5 watts)	longest	Context saved on HDD	Specific Boot from saved image
S5 Soft Off	Shutdown	S5=S4	longest		Complete boot

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Bios Setting defines "Standby" mode to use

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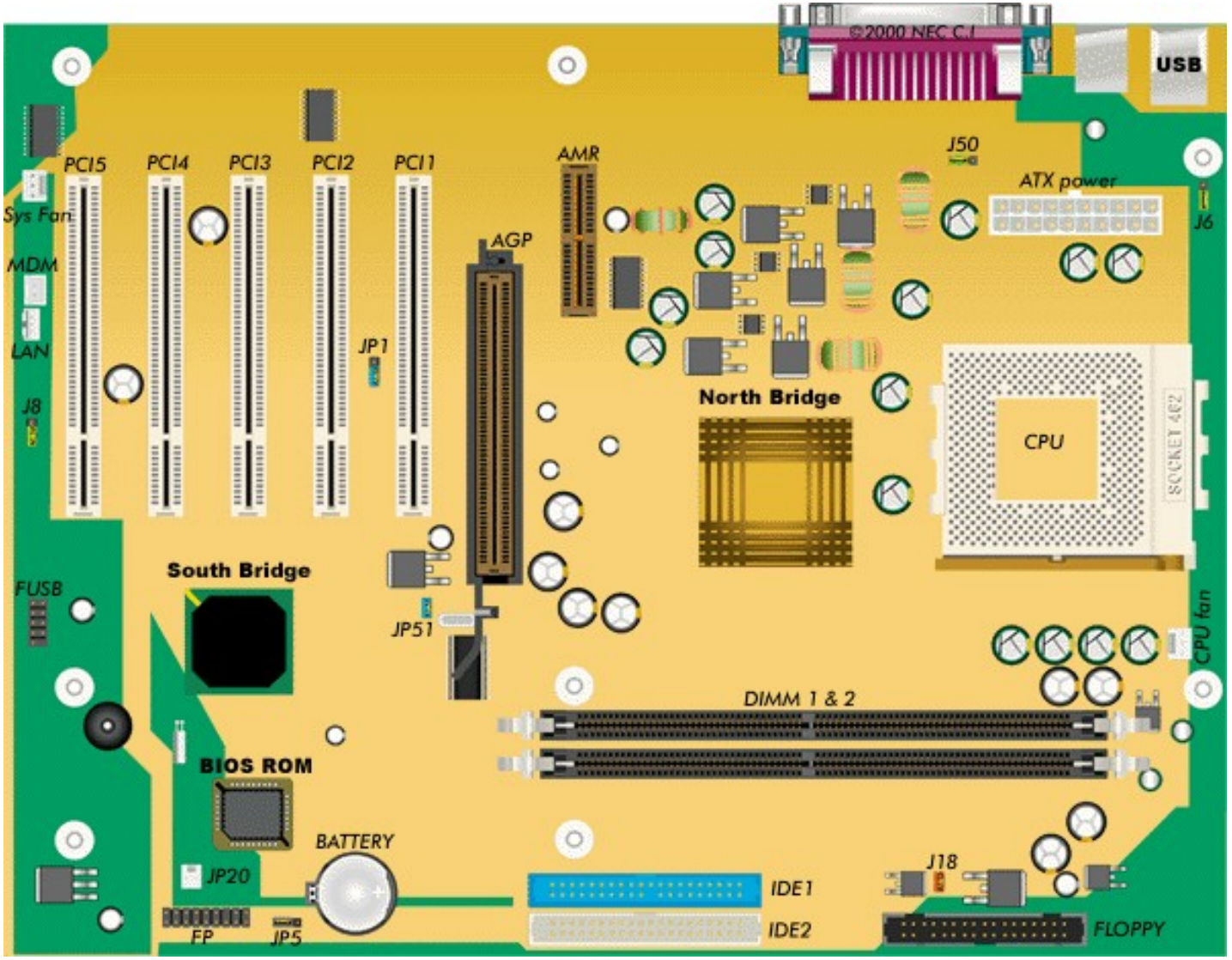
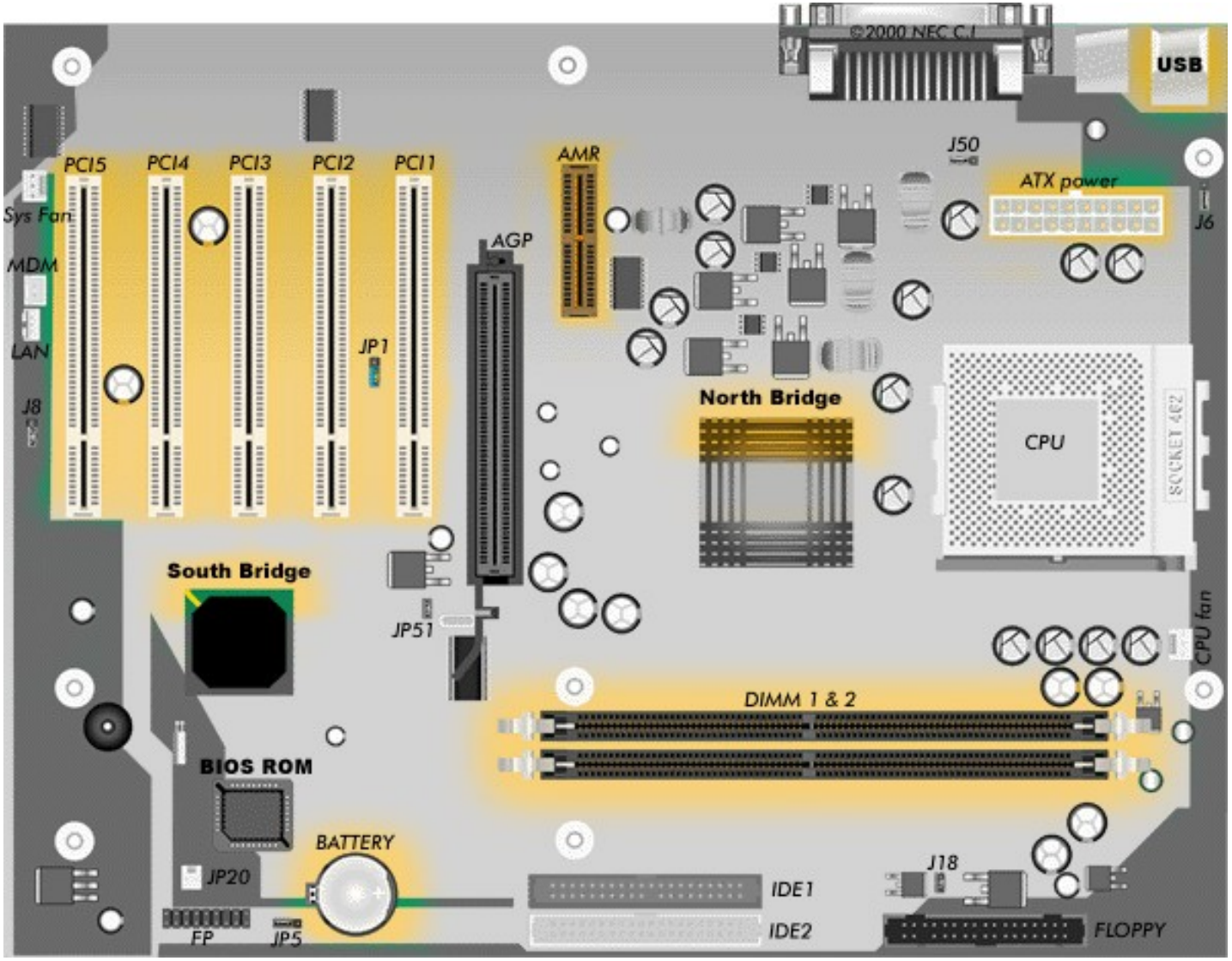
S5 Soft Off	**Shutdown**				Complete boot

State value is used by BIOS to distinguish boot type

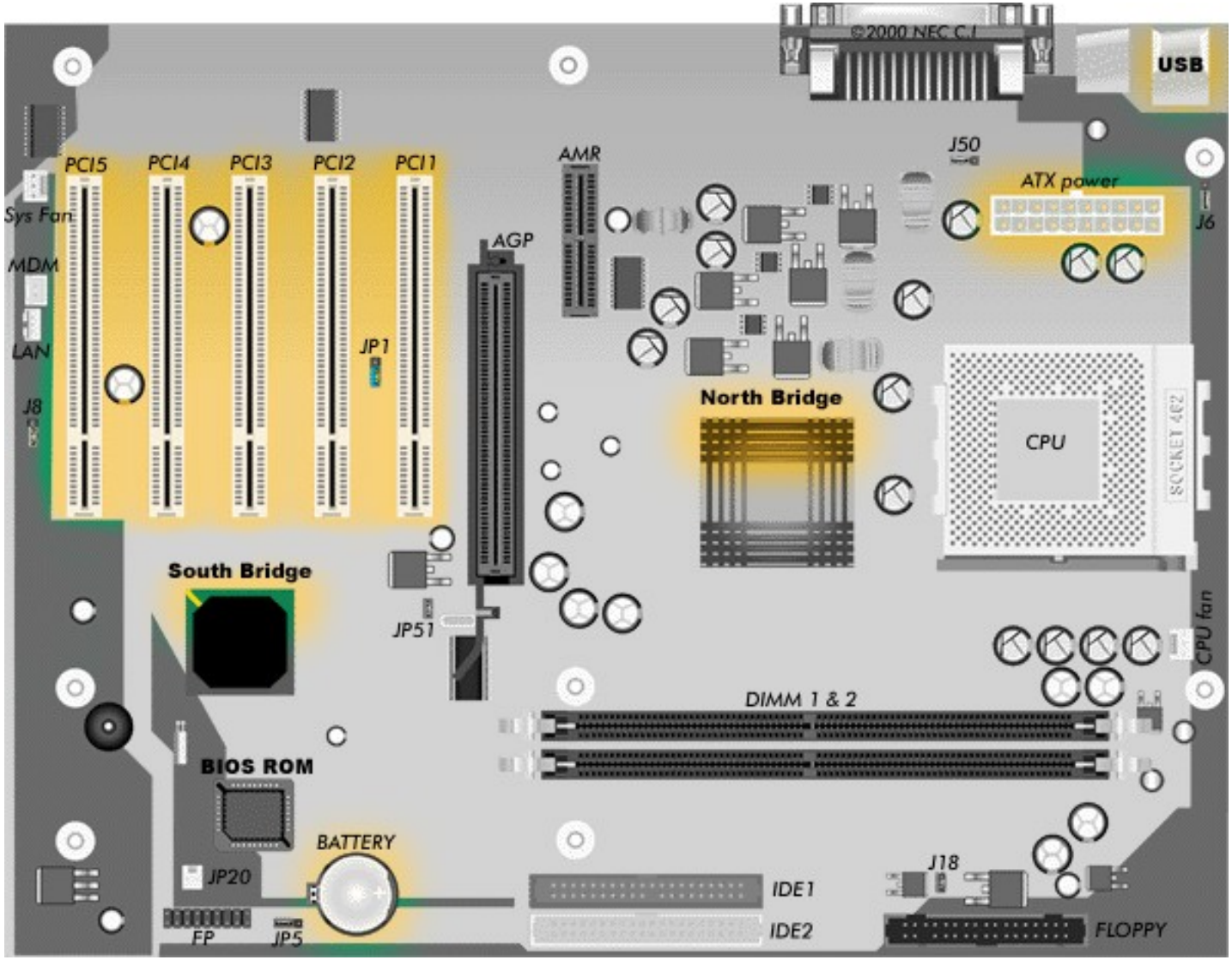
Power Supply Planes - S0, S1



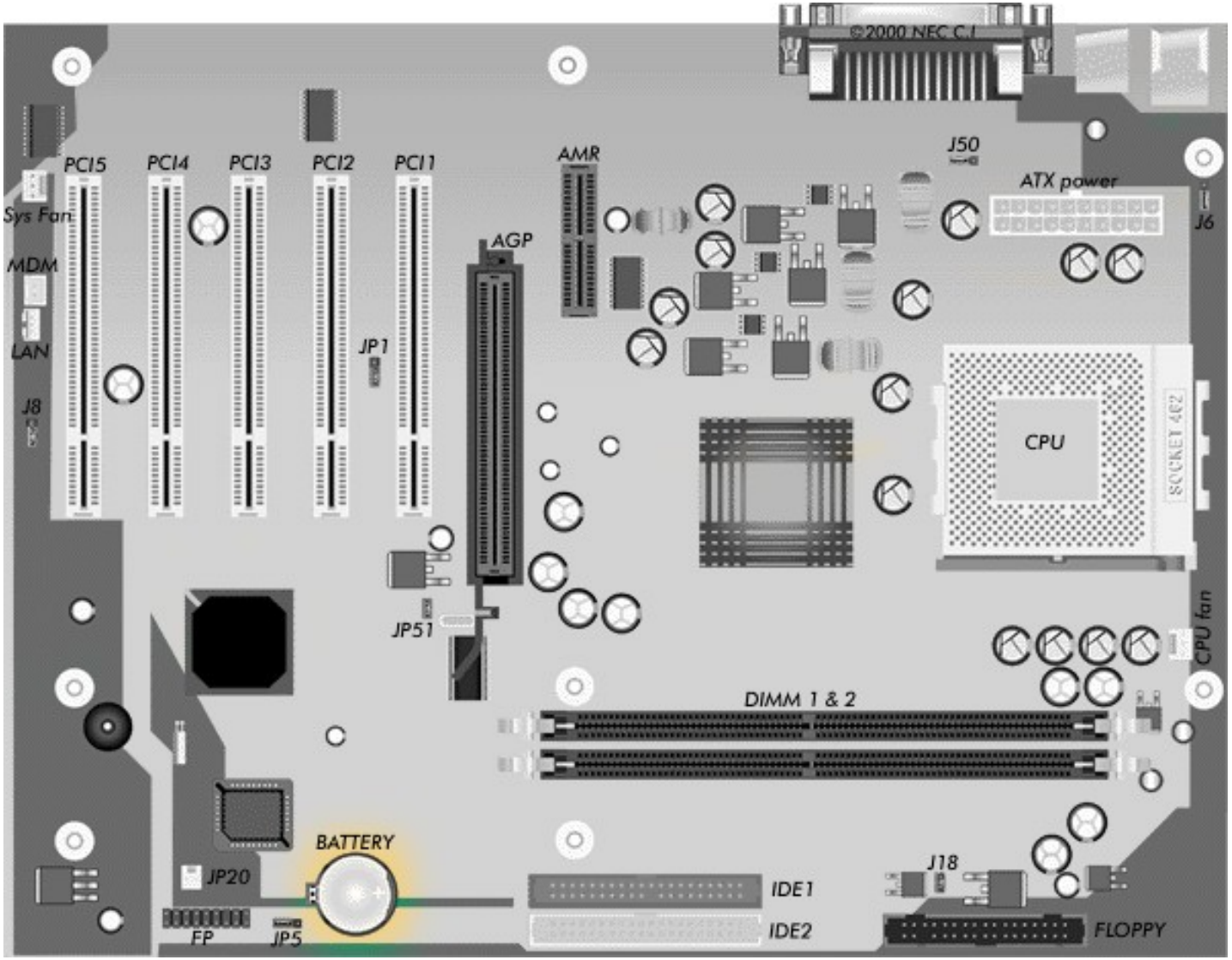
Power Supply Planes - S3 (to RAM)



Power Supply Planes - S4 (to DISK), S5



Power Supply Planes - G3 Unplugged

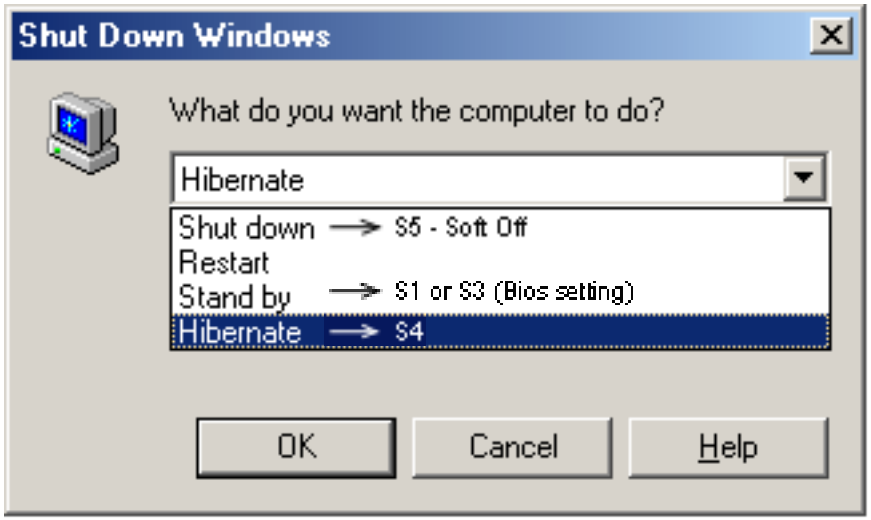


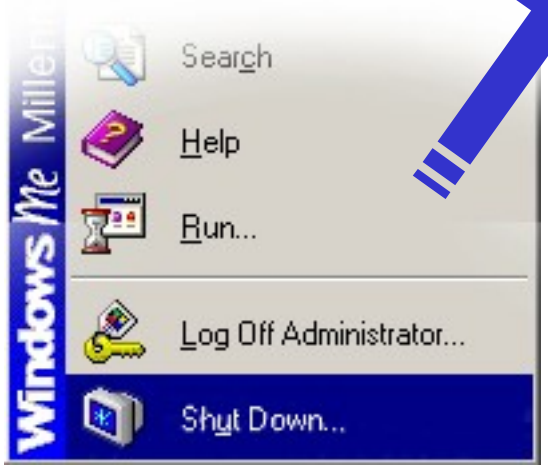
Wake Events

- Before putting the machine in a sleeping state , the OS enables wake on devices.

Current platform capabilities						
Present State	System Switch	RTC	PME (WOL)	Wake On Ring	USB (Kb/Mouse)	PS/2 (Kb/Mouse)
S1	✓	✓	✓	✓	✓	✓
S3	✓	✓	✓	✓	✓	
S4	✓	✓	✓			
S5	✓	✓	✓			

Windows User Interface - Shut Down Windows





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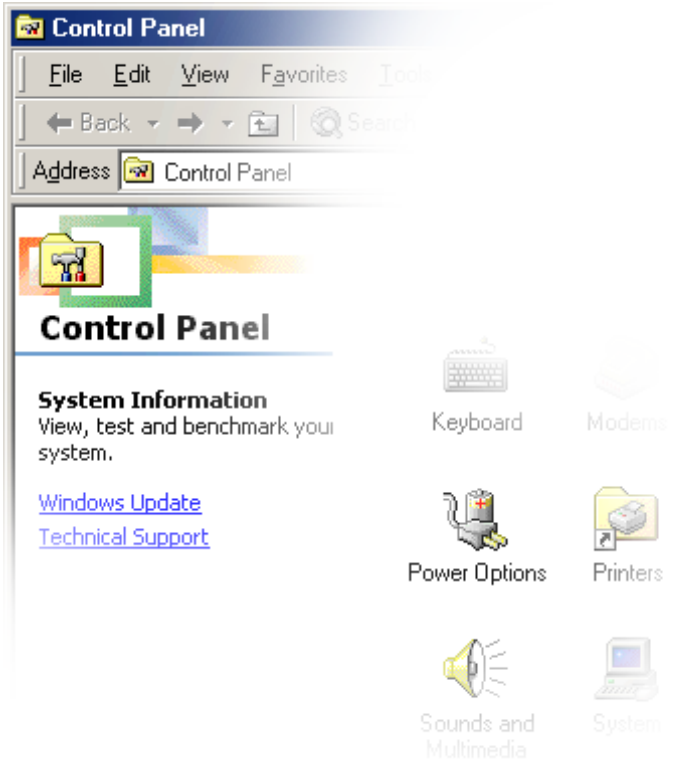


- The user can define:
  - time to standby
  - time to hibernate
  - battery management policy
  - power button behavior
  - ...

ACPI-Aware OS

- To benefit from these features, one requires an ACPI-aware OS.

Windows OS	APM	ACPI			
		S1	S3	S4	S5
Whistler		✓	✓	✓	✓
Wme		✓	✓	✓	✓
W2000		✓	✓	✓	✓
W98se	✓	✓	✓		✓
W95	✓				
NT 4.0					

Useful Links

http://www.teleport.com/~acpi

ACPI 2.0 Specification

ACPI tools

Adopters

Calendar

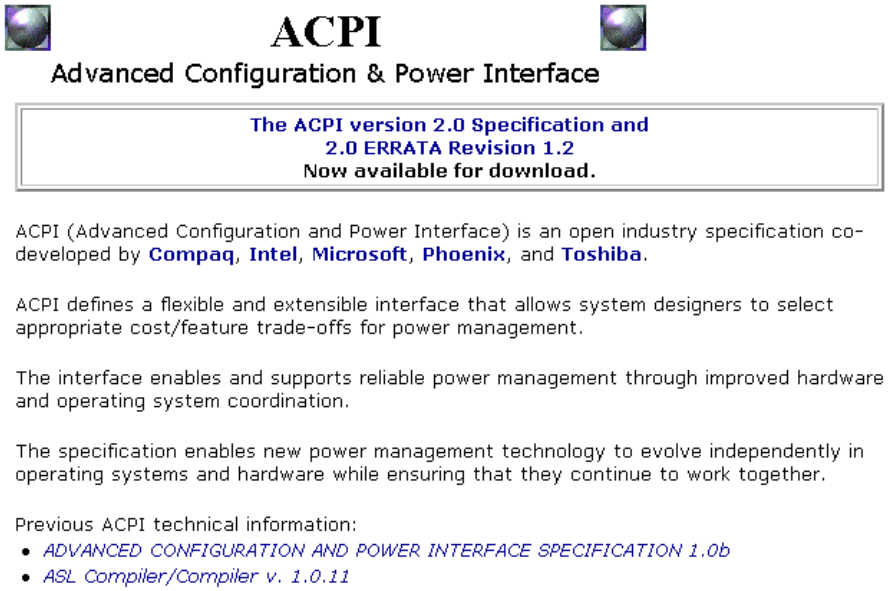
FAQ

Overview

Presentation

Link to Intel, Microsoft

HCT Tests...



ACPI

Advanced Configuration & Power Interface

The ACPI version 2.0 Specification and 2.0 ERRATA Revision 1.2 Now available for download.

ACPI (Advanced Configuration and Power Interface) is an open industry specification co-developed by **Compaq**, **Intel**, **Microsoft**, **Phoenix**, and **Toshiba**.

ACPI defines a flexible and extensible interface that allows system designers to select appropriate cost/feature trade-offs for power management.

The interface enables and supports reliable power management through improved hardware and operating system coordination.

The specification enables new power management technology to evolve independently in operating systems and hardware while ensuring that they continue to work together.

Previous ACPI technical information:

- *ADVANCED CONFIGURATION AND POWER INTERFACE SPECIFICATION 1.0b*
- *ASL Compiler/Compiler v. 1.0.11*

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Open Questions