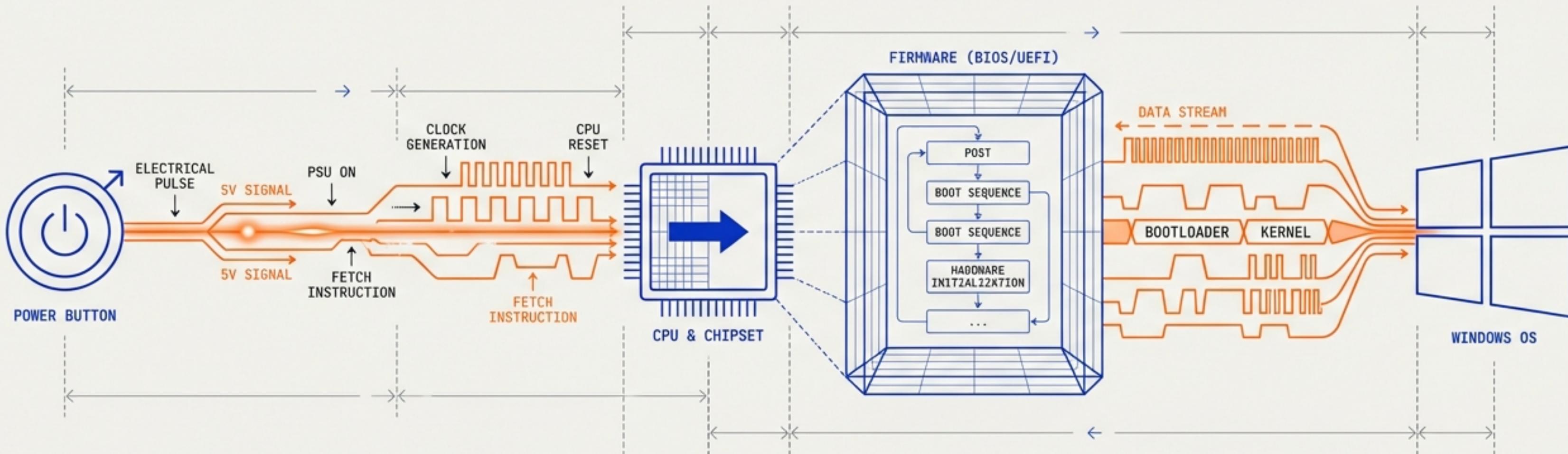


From Zero to One: The Anatomy of a PC Boot

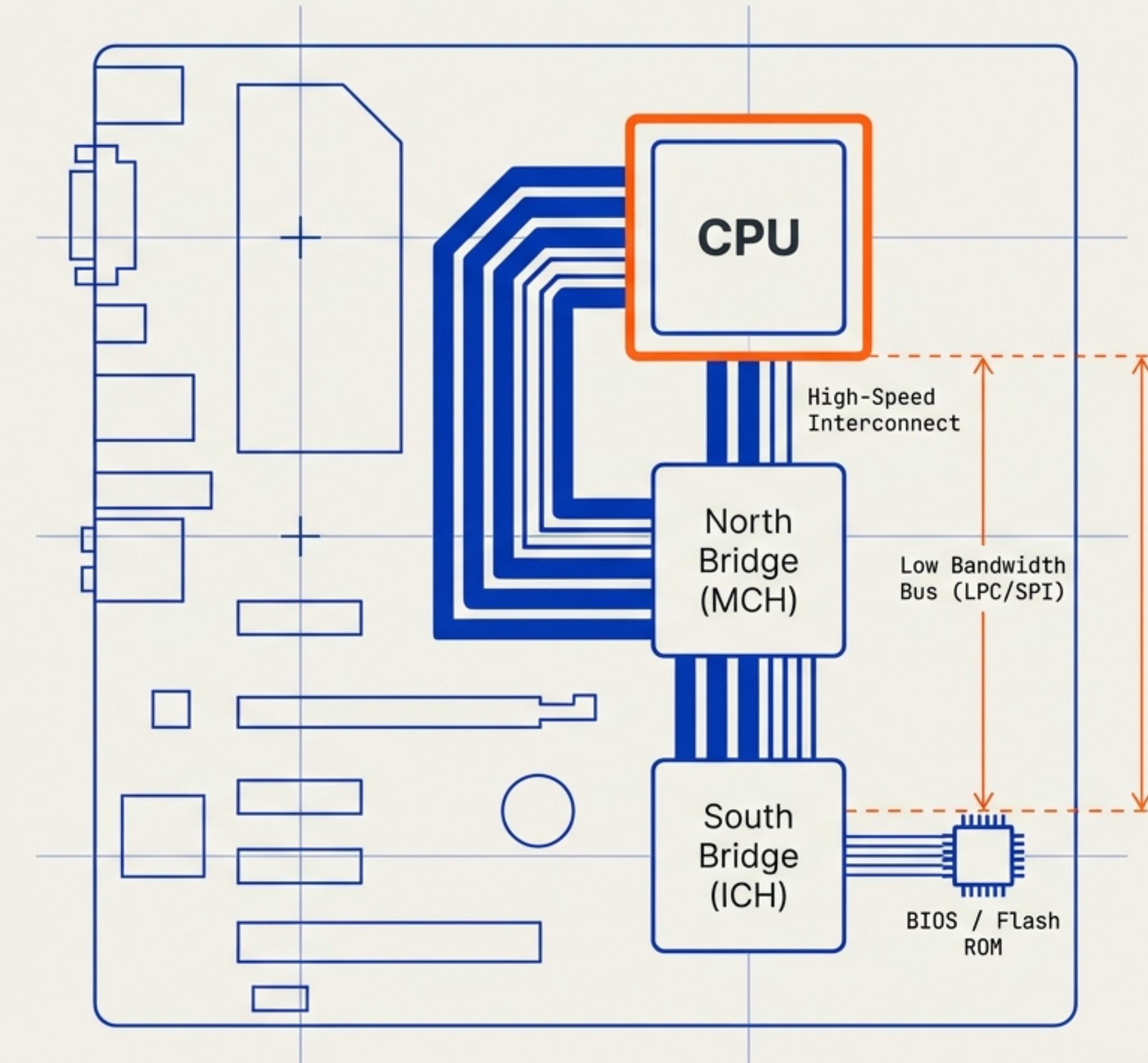
Tracing the journey from the power button to the Operating System.



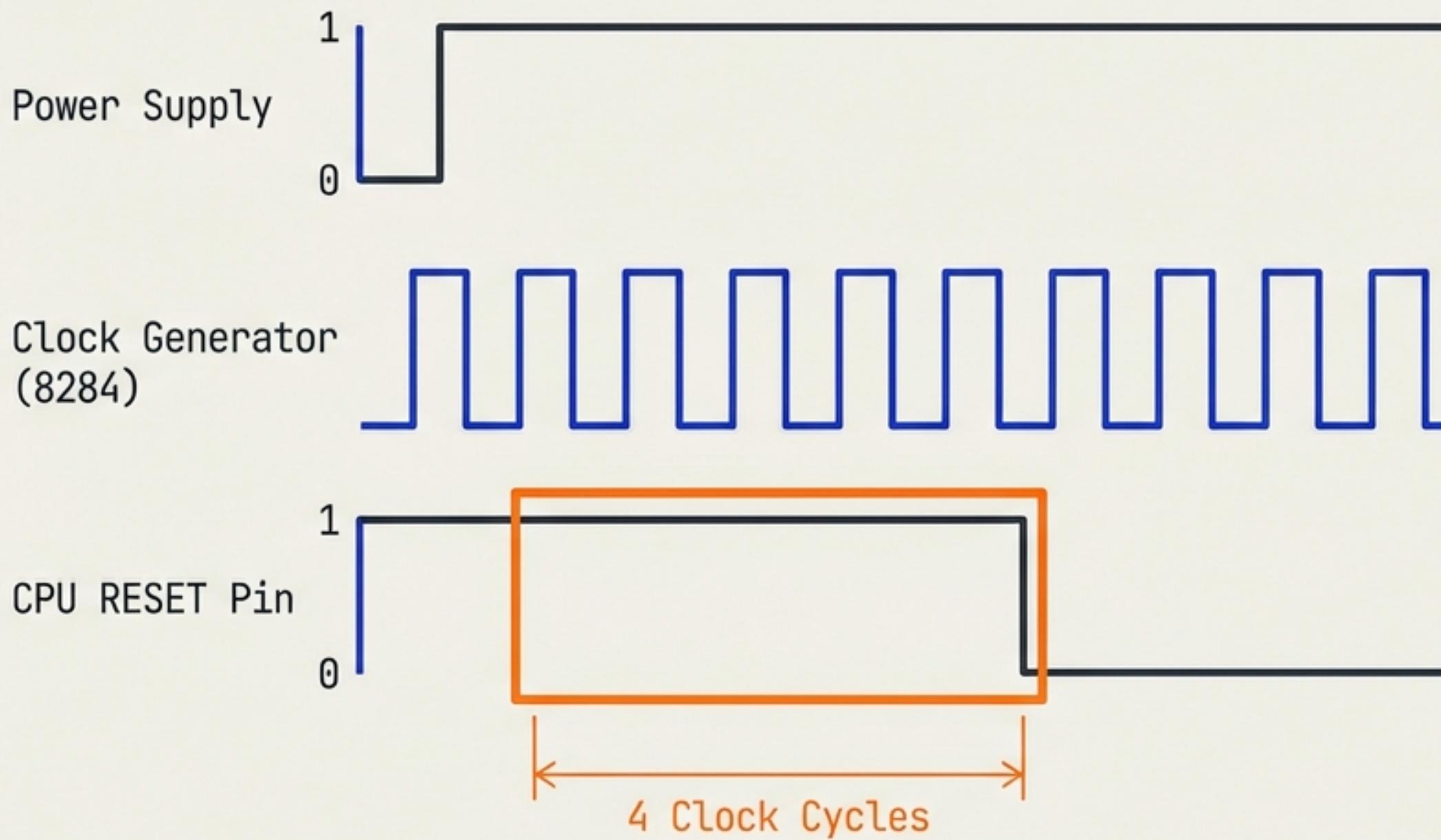
A computer boot is a high-speed relay race. The “baton” is control of the system. This visualization traces the precise moments execution is handed off—from the electrical spark of the **CPU** to the firmware, the storage, and finally the **Operating System**.

The Stage: Chipset Geography

- **The Processor:** The brain, initially waiting for instructions.
- **North Bridge:** Connects CPU to high-speed RAM and Graphics.
- **South Bridge:** Connects slower I/O devices. This is where the BIOS chip physically resides.



The Spark: Waking the Silicon



Step 1: Power Button Pressed.

Step 2: Clock Generator sends "Power Good" signal.

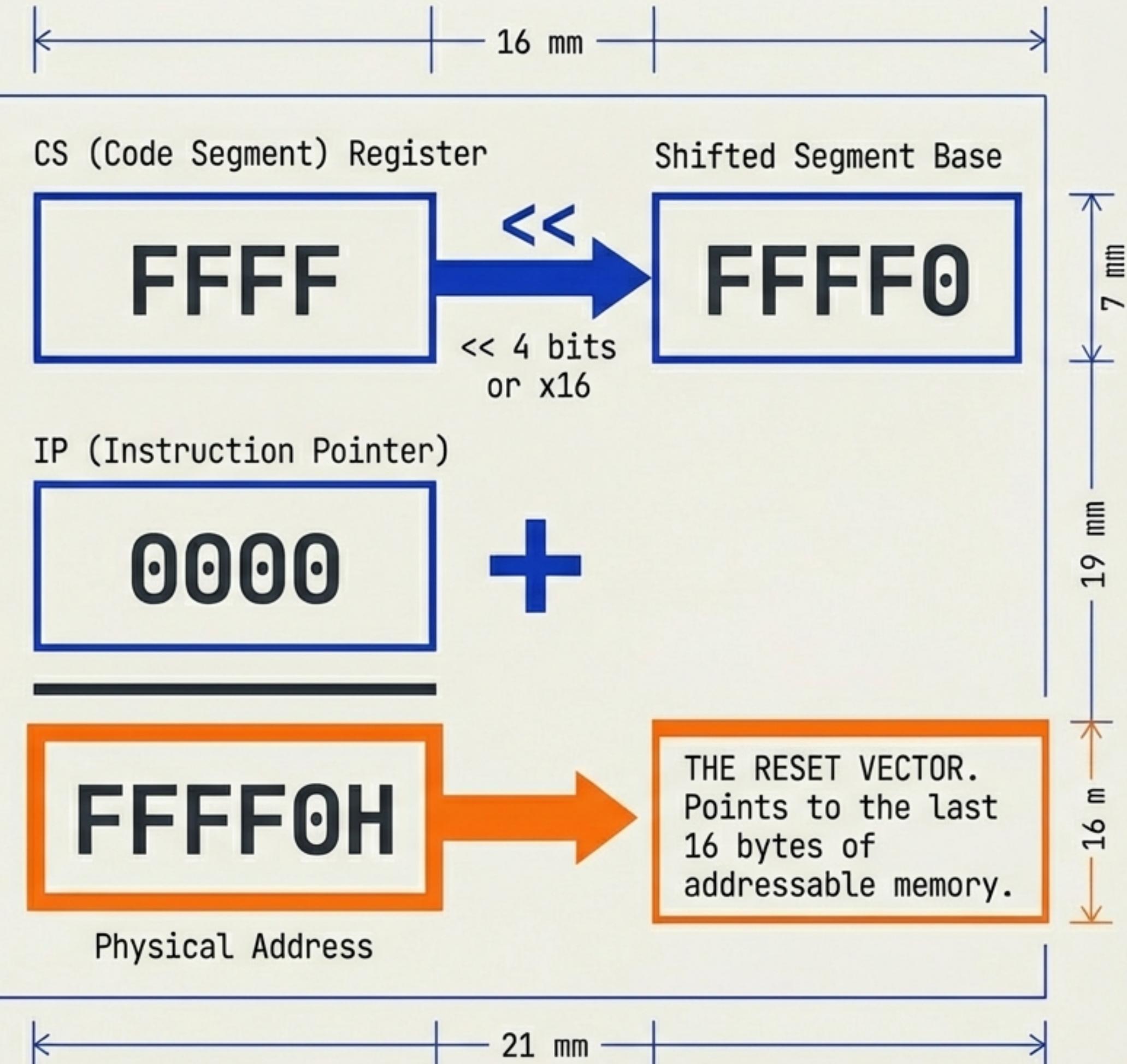
Step 3: RESET pin held HIGH for 4 clock cycles.

Step 4: Signal drops LOW. CPU wakes up.

The CPU is "brain dead" with empty registers until the Reset Pin signal drops.

The First Thought: The Reset Vector

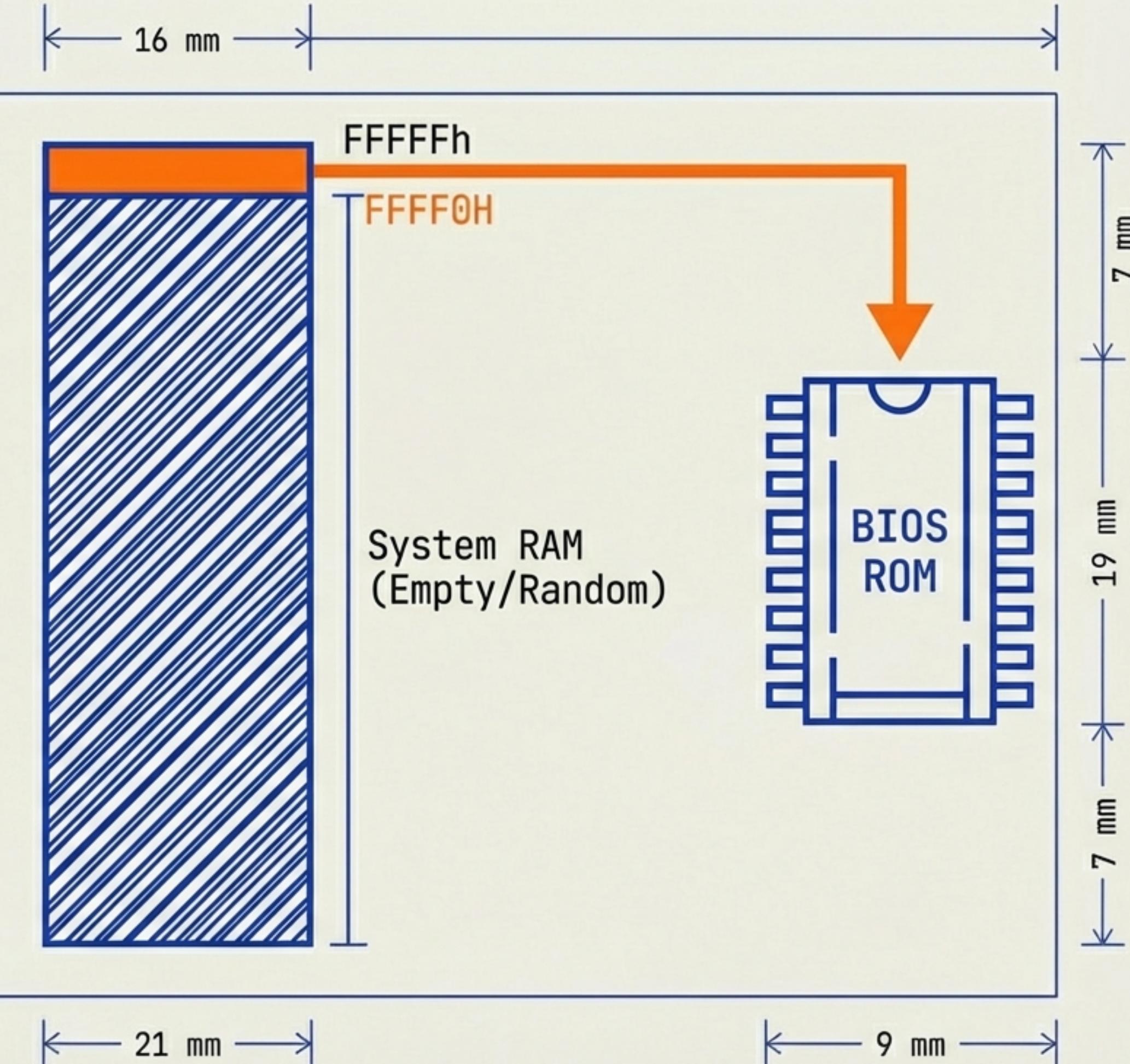
How does the CPU know where to start? It is hardwired to calculate a specific physical address immediately upon waking.



Execute in Place (XIP)

The RAM is currently unusable.
The CPU maps the Reset Vector
address directly to the BIOS
ROM chip.

Address: FFFF0H
Instruction: JMP F000:E05B
(Jump to BIOS Start)



The Inspection: Power On Self Test (POST)

Verify CPU Registers



BIOS Integrity Checksum

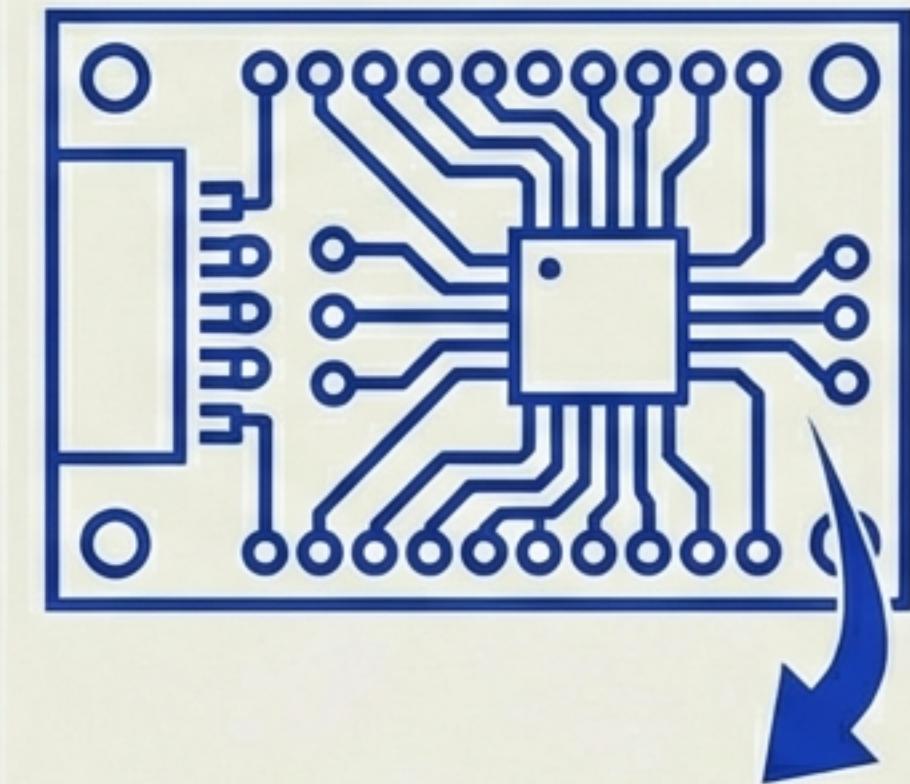


Initialize RAM & Peripherals



Diagnostics

Port 80



Diagnostics before Video:
The system communicates via Beep Codes (Speaker) and Hex Codes sent to I/O Port 80.

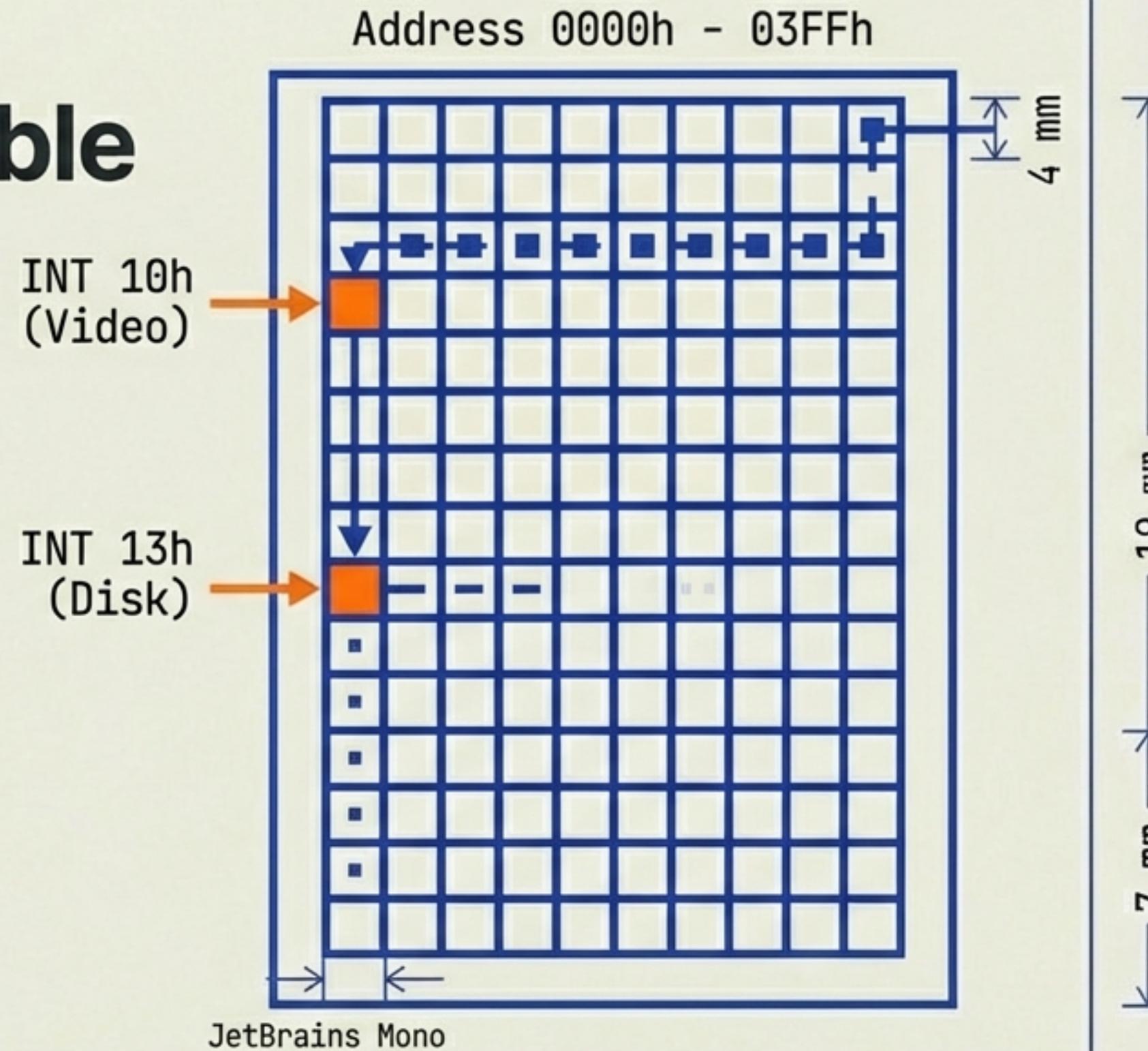
21 mm

12 mm

Building the Dictionary: The Interrupt Vector Table

The BIOS fills the first 1KB of RAM with addresses (vectors). This creates a translation map allowing software to talk to hardware.

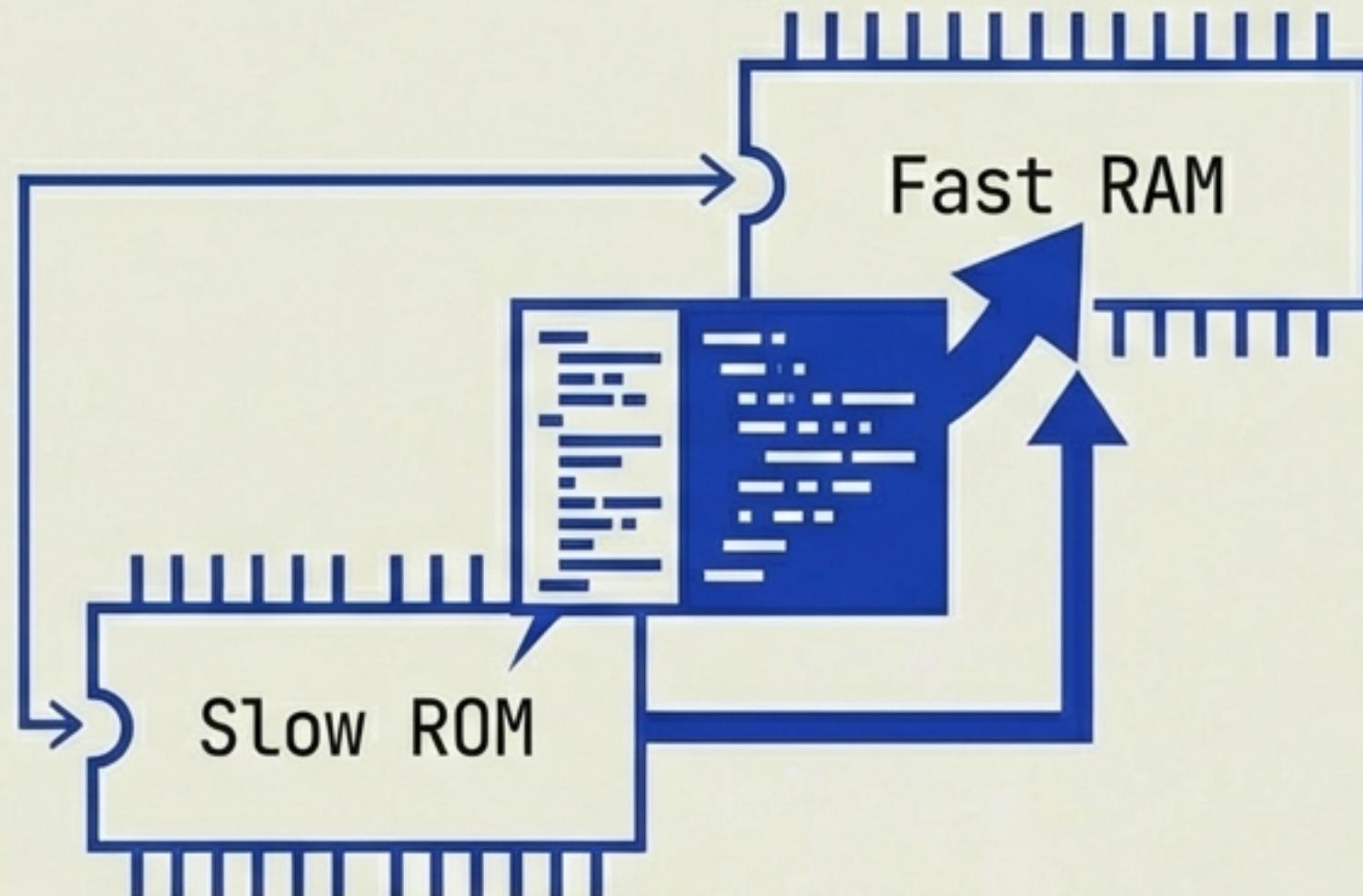
256 Vectors created.
256 Vectors created.
4 Bytes per Vector.



16 mm

Optimization: Shadowing & The Boot Check

BIOS Shadowing



BIOS Shadowing for speed.

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The Boot Check Fork

Check Address 0472H

Value =
1234H

Warm Boot
(Skip RAM Test)

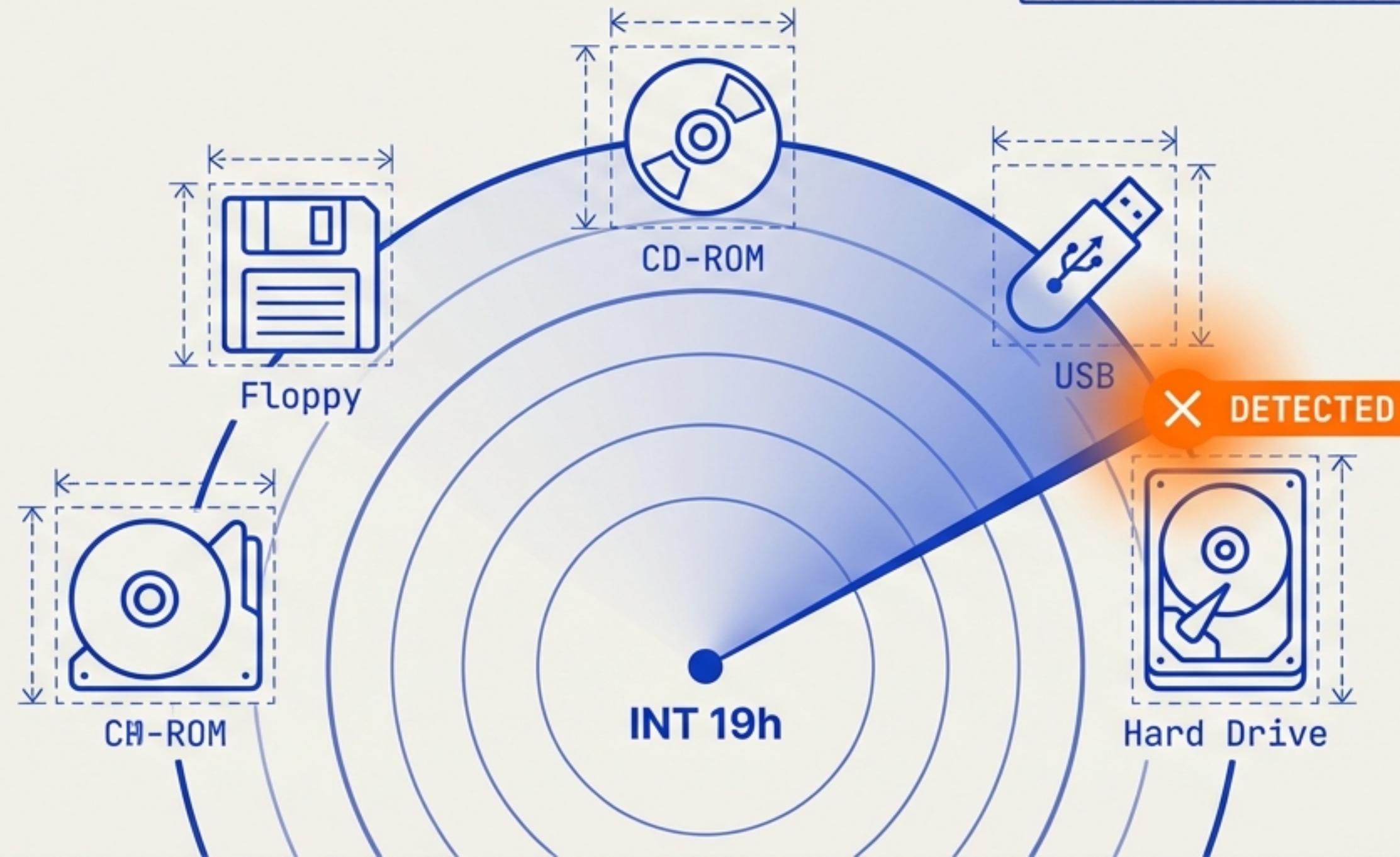
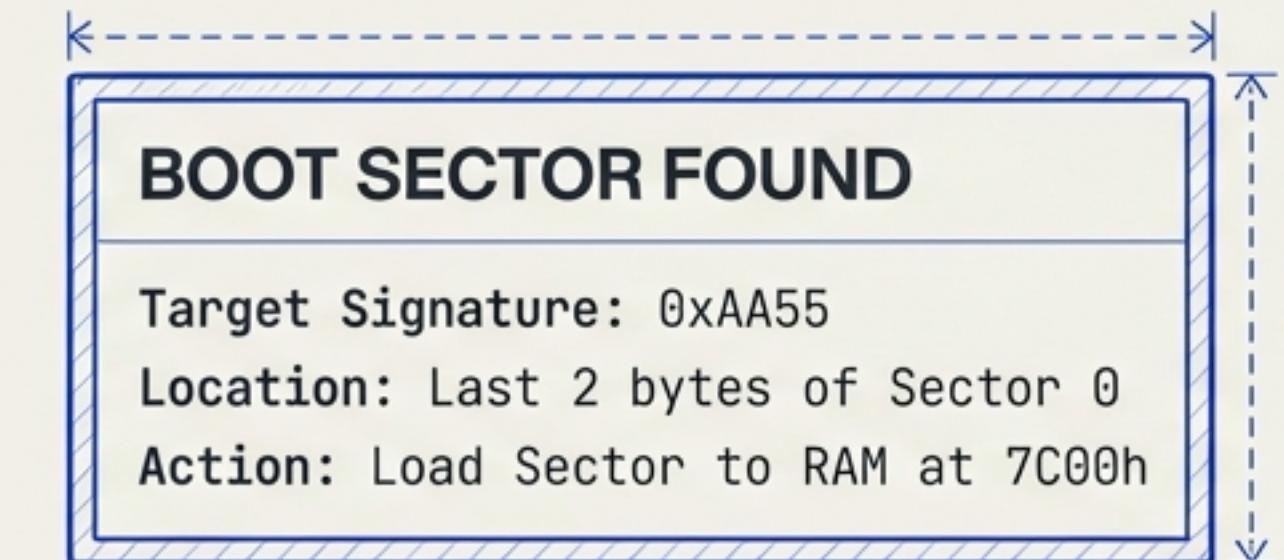
Value != 1234H
Cold Boot
(Full Test)

19 mm

21 mm

The Search: Interrupt 19h

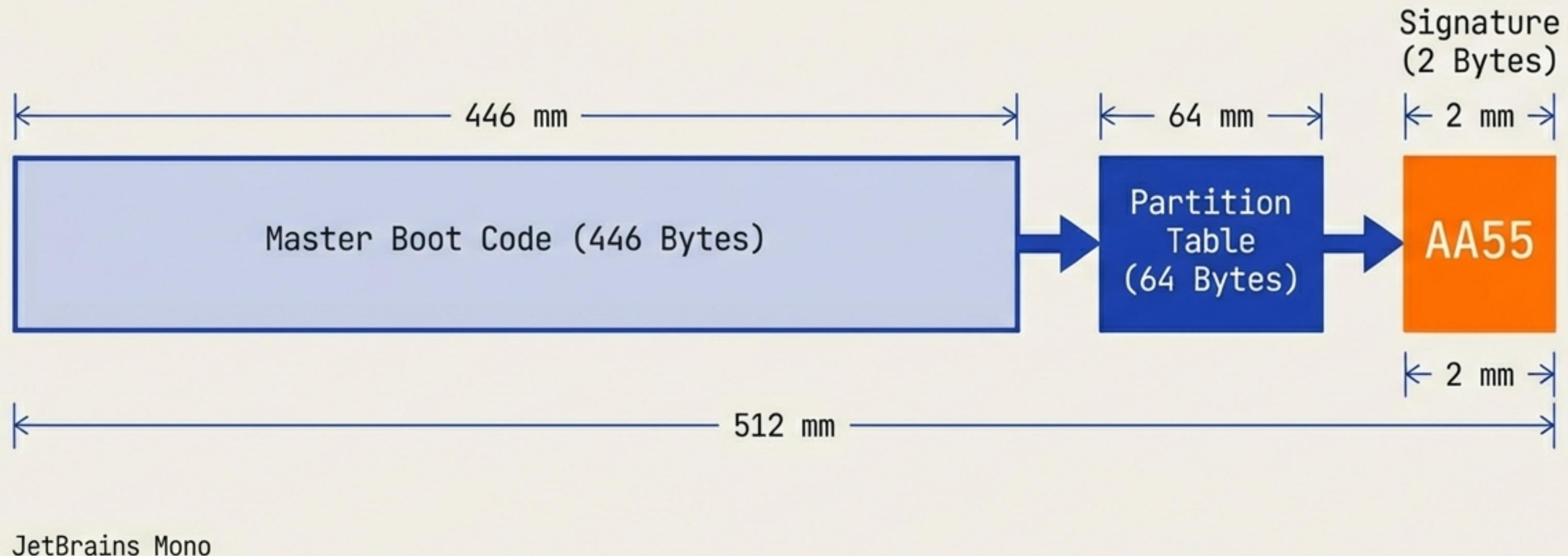
POST is complete. The BIOS scans boot devices in priority order.



Anatomy of the Master Boot Record (MBR)

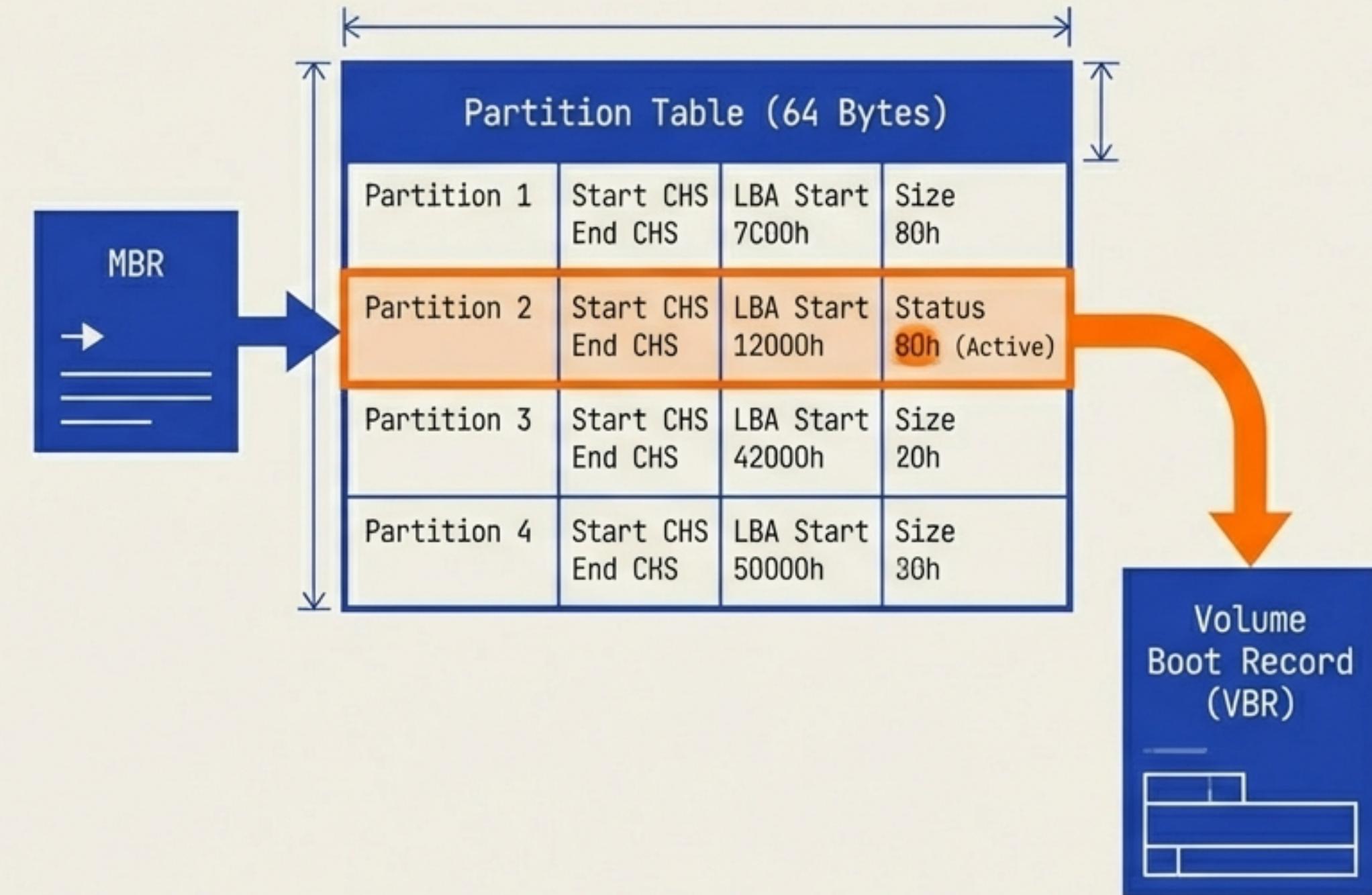
The very first sector of the physical disk.

The very first sector of the physical disk.



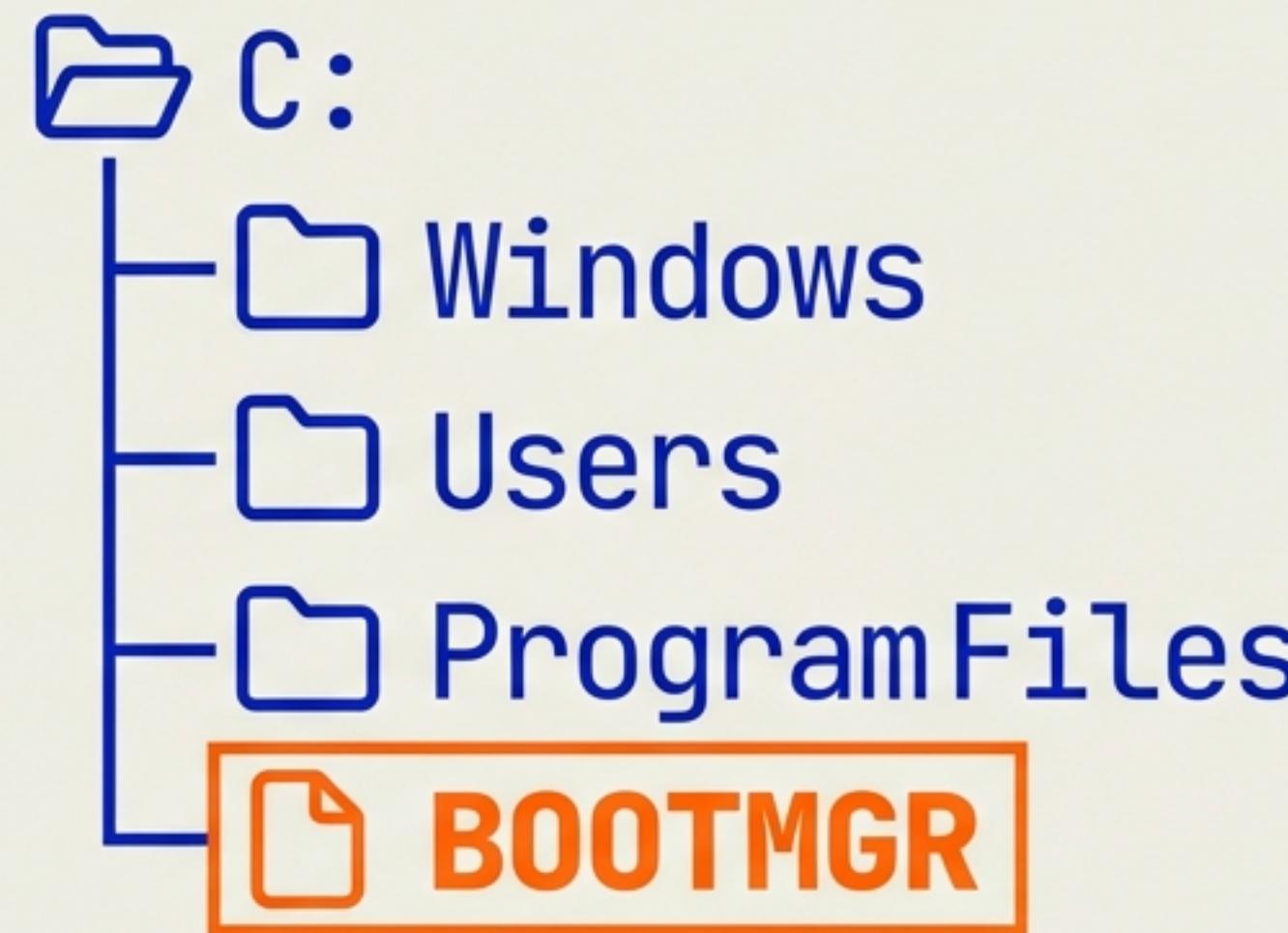
The Baton Pass: MBR to VBR

The MBR's only job is to find the Active Partition (marked with hex 80) and load its specific Volume Boot Record.



Insight: The MBR is the building manager.
The VBR is the tenant.

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Loading the Manager

The VBR code understands the file system (NTFS). It searches the root directory for the Windows Boot Manager.

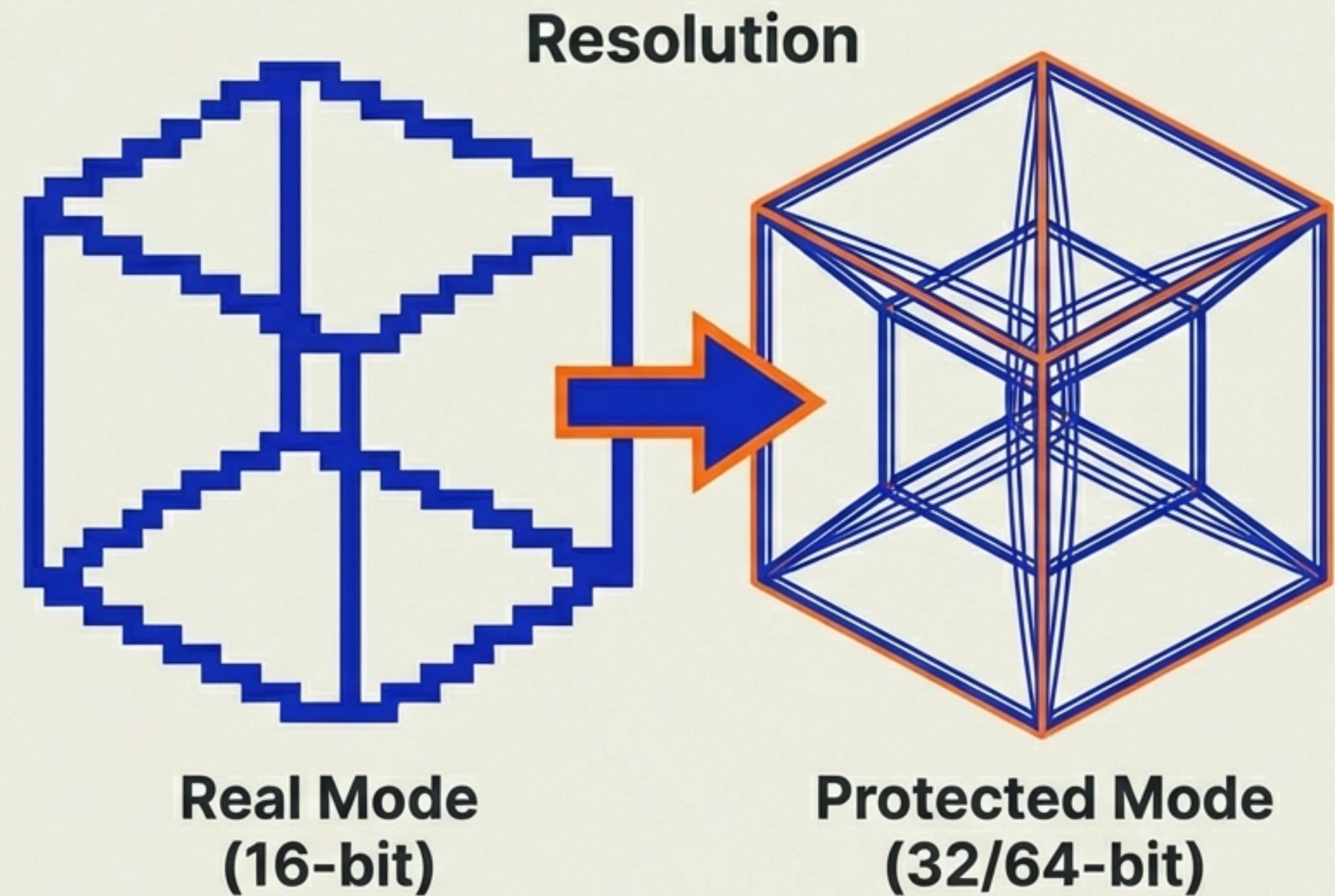
If not found:
“BOOTMGR is missing”.

The Metamorphosis

BOOTMGR switches the CPU from Real Mode (ancient compatibility) to Protected Mode.

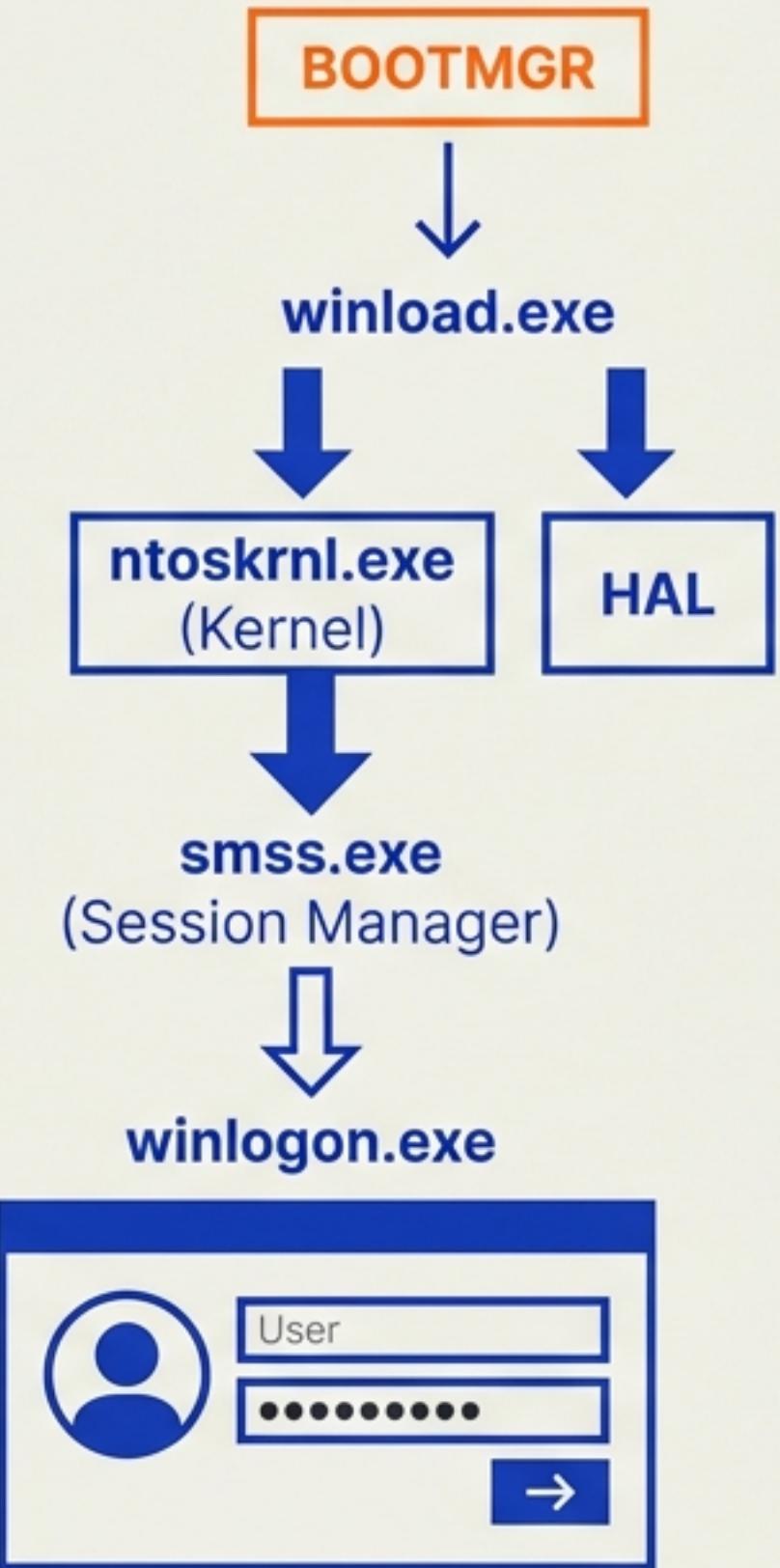
- Enables Paging (Virtual Memory)
- Access to all RAM
- Hardware Protection

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“The Final Stretch”

Drivers load. The kernel takes command. The relay race ends when the user sees the login screen.



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Glossary: Secrets of the Machine

Data Sheet

FFFF0H	Reset Vector (First Instruction Address)
INT 19h	Bootstrap Loader Interrupt
AA55	Boot Signature (End of Sector Marker)
7C00H	Memory Address for Boot Sectors
0472H	Warm Boot Check Address
80h	Active Partition Flag

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