Remote Wake-Up

Intel Corporation

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Agenda

- RWU purpose and popular topics
- RWU and standard LOM/NIC
- RWU design considerations
- Networking support model

RWU Purpose and Popular Topics

RWU and Manageability

- RWU and PXE provide the first two fundamental building blocks of WFM
  - Remote boot and remote network connection
- RWU provides the first link to WFM
  - The ability to power-down a system and still remain virtually connected to manageability services
- RWU is a requirement for NetPCs
- RWU is OS-independent and can be functional without ever previously booting the PC
- For OS upgrades/installs, RWU is the key to “out of the box” WFM-ready systems

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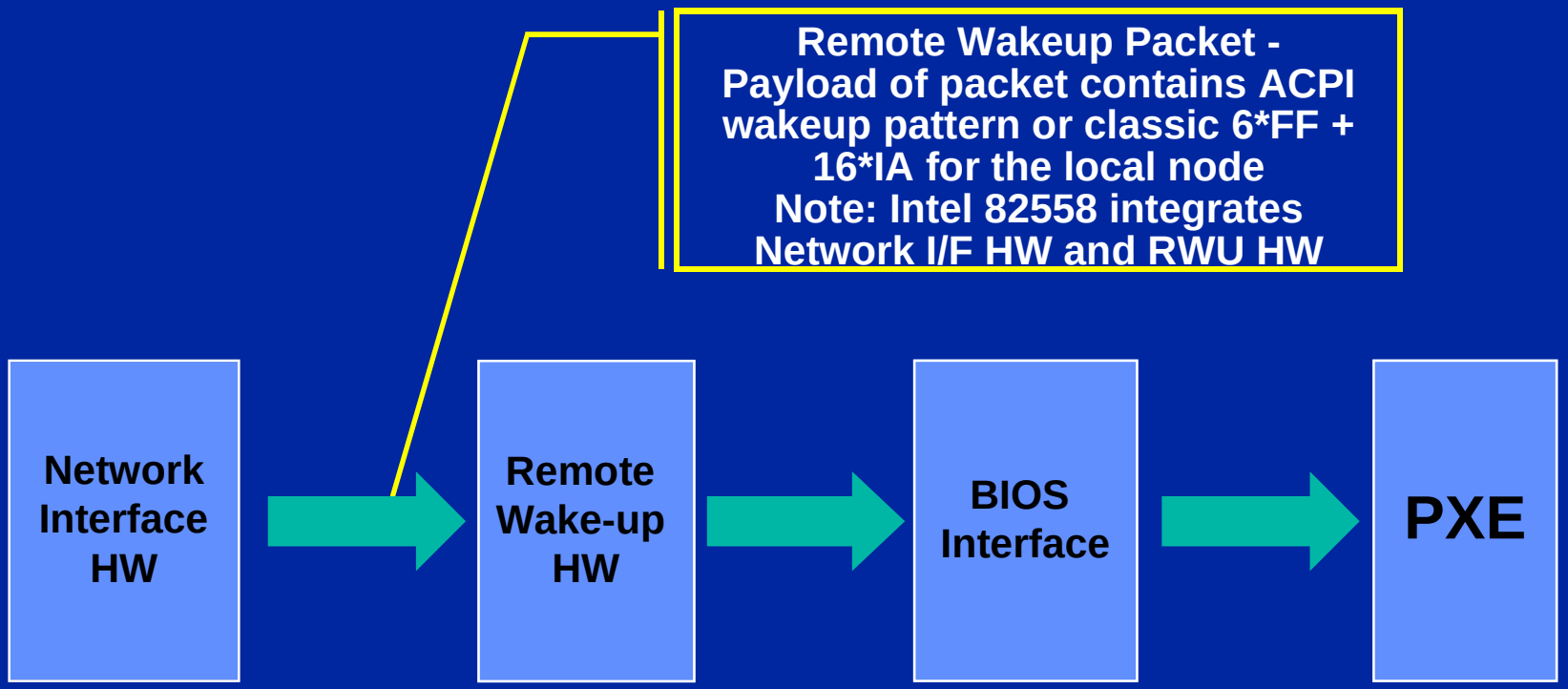
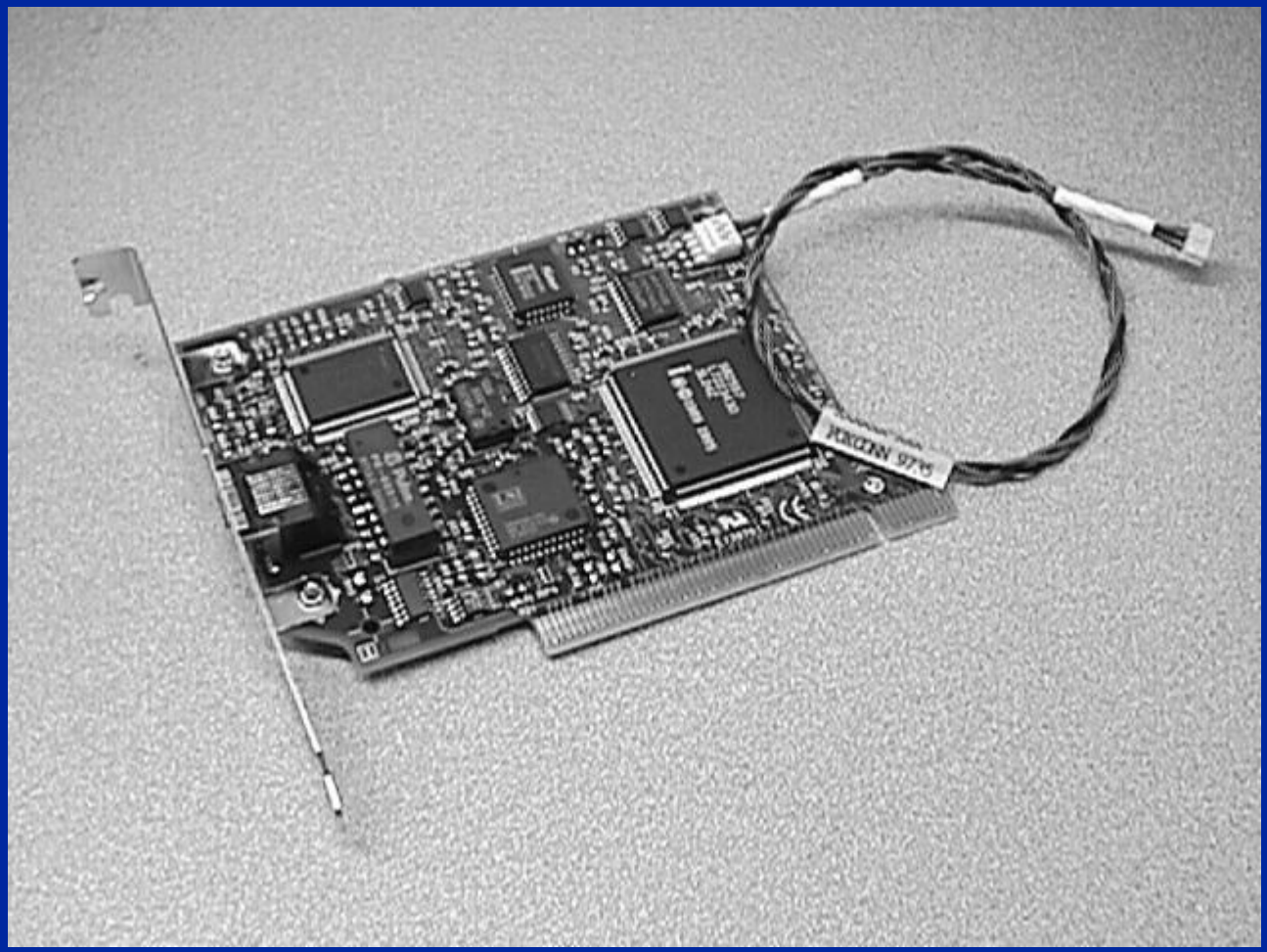
Remote Wake-up



RWU Flavors

- RWU can be implemented as a NIC (Network Interface Card) or LOM (LAN-On-Motherboard)
- The RWU NIC requires certain system modifications - no easy install
- The RWU LOM also requires modifications, but these are incorporated during the design cycle

WOL Header



Then Why LOM?

- LOM reflects the trend in sharing network manageability between networking silicon and the chipset
- Avoids non-standard cabling used for RWU NICs
- Compatibility within system is assured
- Allows further integration with system capabilities
- Allows network performance tuning

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RWU in the APM Context

- APM represents existing (legacy) power management implementations - linked to, say, Windows* 95 Suspend mode functionality
- APM is implemented at BIOS level
- APM performs power management at a system level (no device level granularity in power control)
- APM typically supports:
  - Full power
  - Screen saver mode
  - Suspend mode
  - No power states
- APM triggers wake from suspend for events like keyboard or mouse activity - configurable
- RWU wakes the system from the no power or suspend modes - depending on configuration
- Intel 82557 and 82558 support APM RWU and can HW-initialize

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RWU in the ACPI Context

- ACPI represents future power management implementations - linked to 1998 MS OSs
- ACPI is implemented at OS level
- ACPI performs power management at a system, bus, or device level
- ACPI supports:
  - System power management (G0-3/S0-3)
  - Bus power management (B0-3)
  - Device power management (D0-3)
- ACPI triggers a change in power management state based on well-defined OS policies
- In an ACPI OS, RWU functions as one of multiple wake events capable of changing the system/bus/device power management state
- Intel 82558 is fully ACPI-compliant, supports D0-3 device states, wake events in all states, and provides a low cost/power single chip networking solution for WFM

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RWU LOM/NIC and Standard LOM/NIC

- RWU uses all of the same support and implementation tools as a standard LOM
- RWU takes advantage of the drivers, compatibility history, and support of NIC SW
- A networking solution providing RWU should behave exactly the same during normal traffic as a networking solution with the same component and without RWU
- RWU solutions require different power solutions, additional receiver circuits, and special attention to the existence of powered-up and powered-down circuits in close proximity

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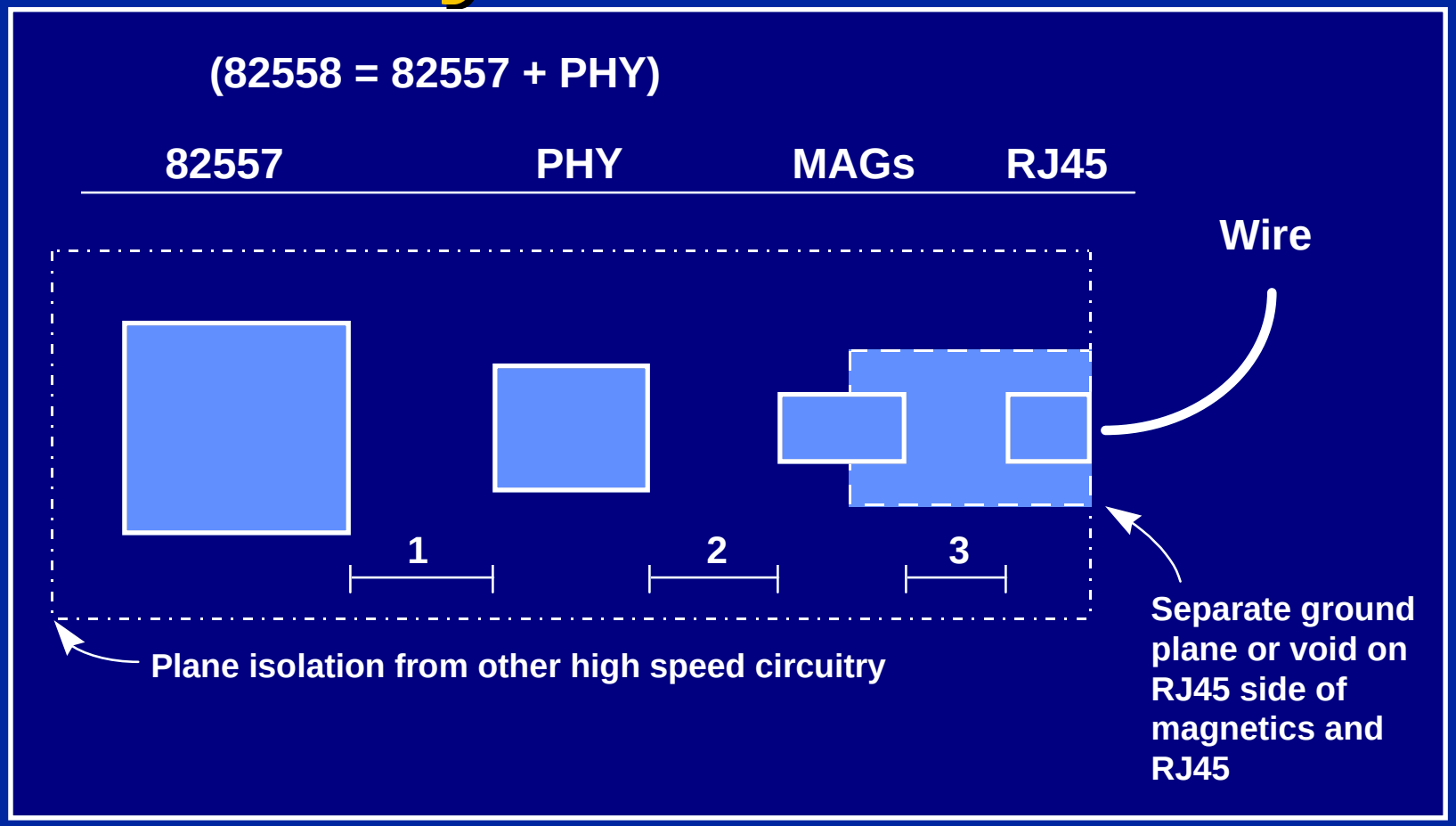
RWU Design Considerations

82557 Layout Considerations



1 - MII signals; minimize length; 68 Ohm traces; priority 3.
2 - PHY->Mag signals; <1" length; route pairs together; 50 Ohm traces; priority 2.
3 - Mag ->RJ45 signals; shortest length possible; route pairs together; 50 Ohm traces; Priority 1. If these traces must be longer, identical trace geometries must be observed to avoid reflections and return loss failures.

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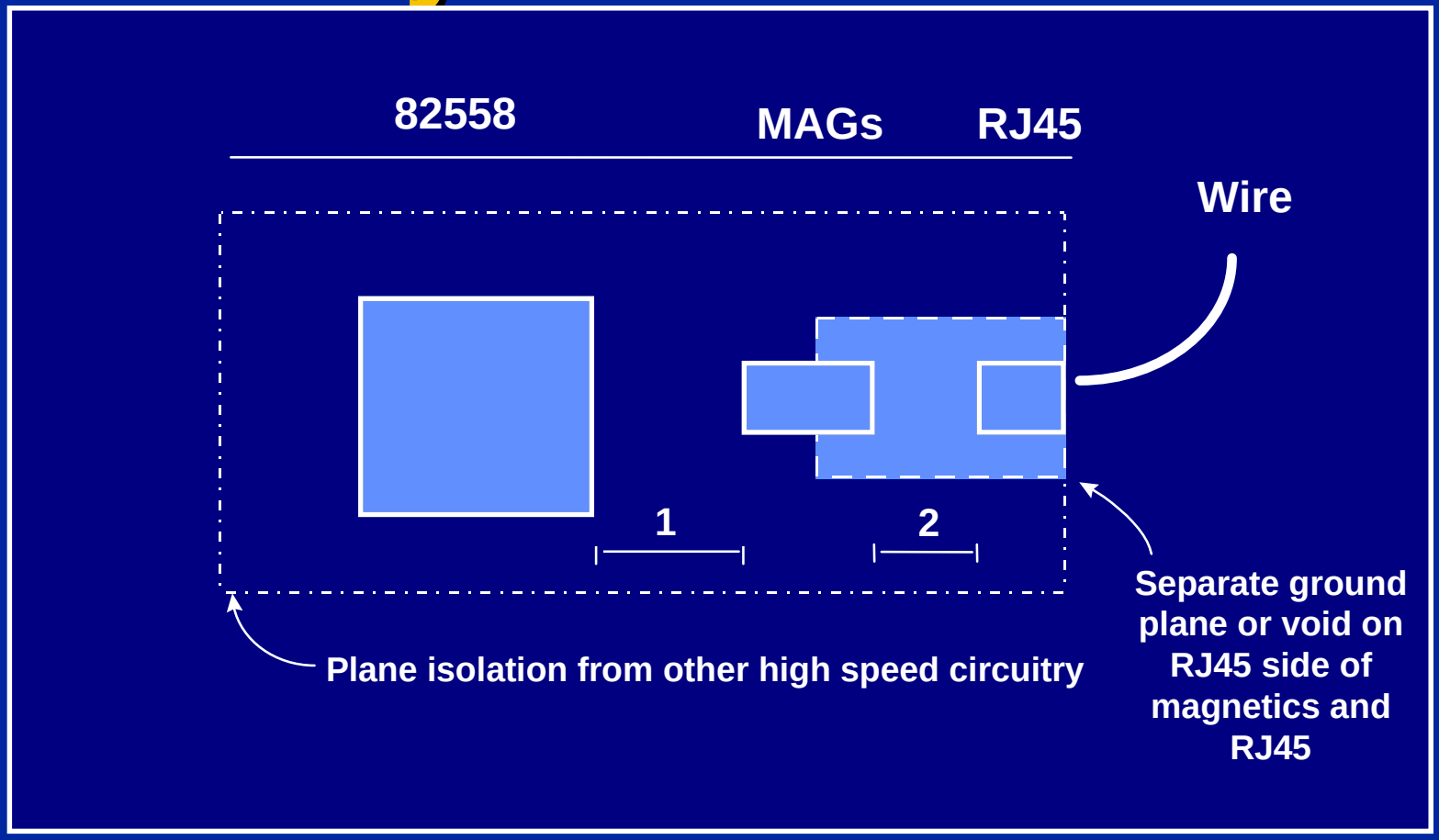
82558 Layout Considerations



1 - 82558->Mag signals; <1” length; route pairs together; 50 Ohm traces; Priority 2.
2 - Mag ->RJ45 signals; shortest length possible; route pairs together; 50 Ohm traces; Priority 1. If these traces must be longer, identical trace geometries must be observed to avoid reflections and return loss failures.

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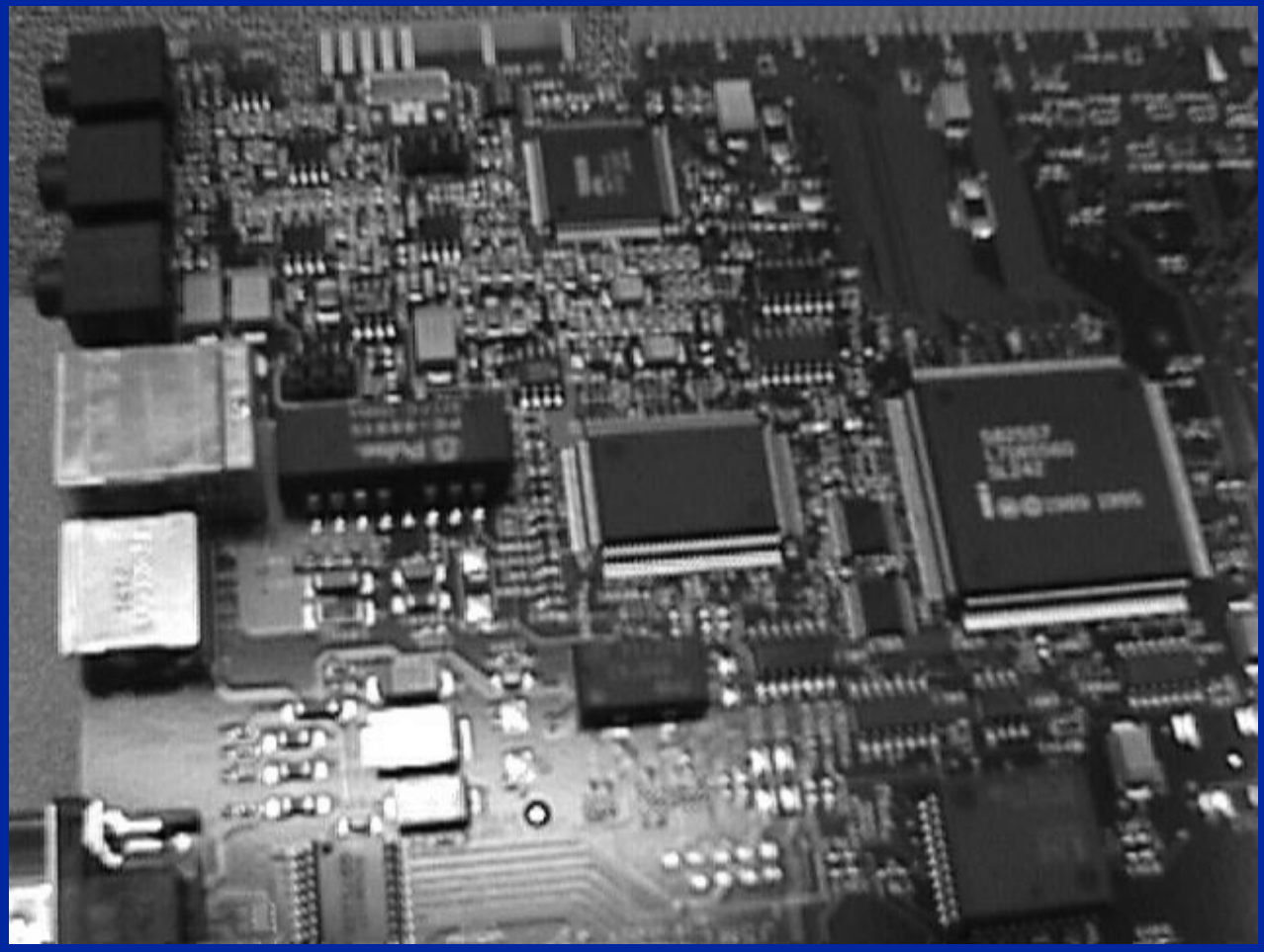
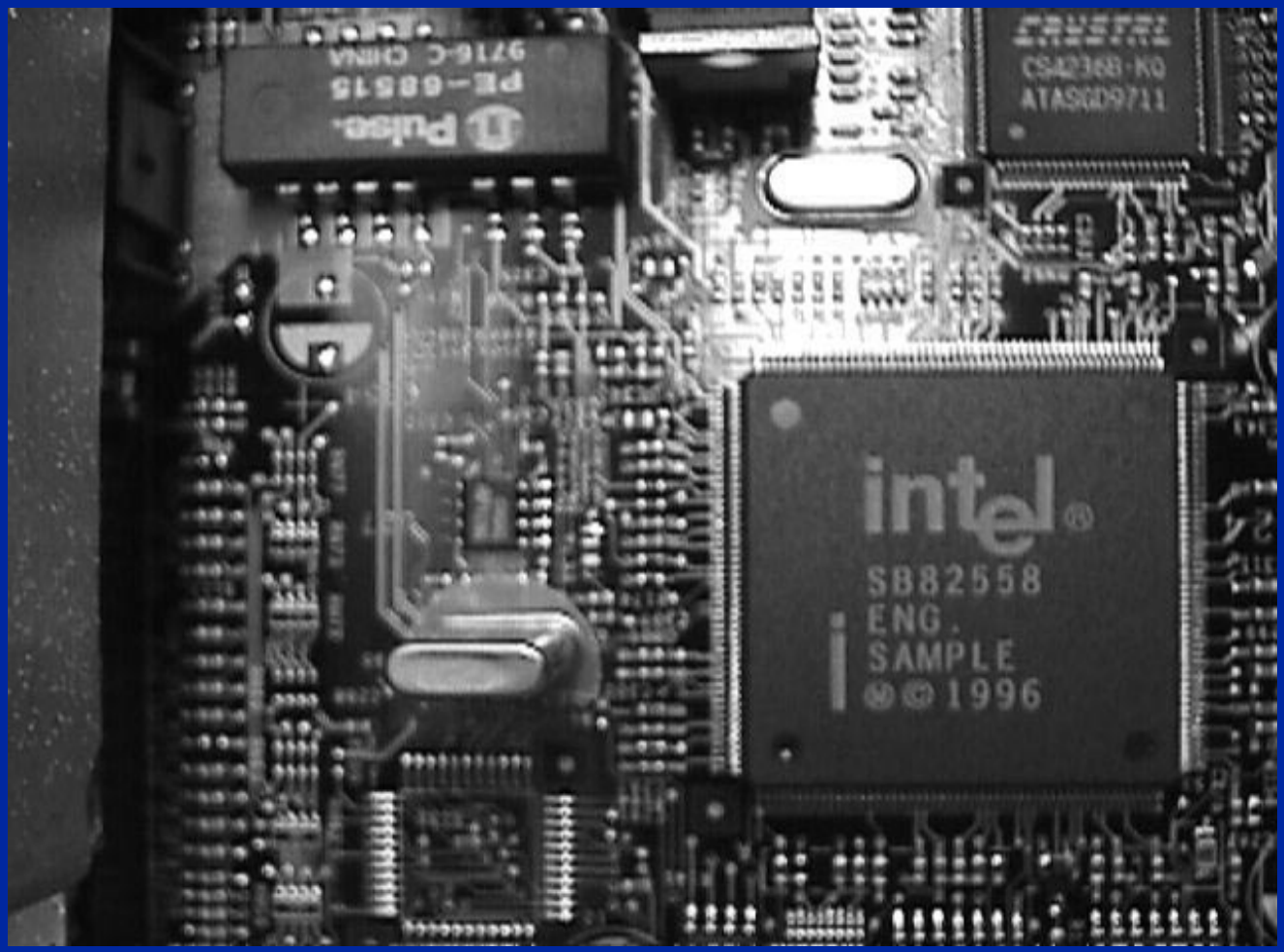
82557 And 82558 Implementation



82558 Implementation



Power Supplies and Connectors

- All power supplies supply some amount of auxiliary current for support circuitry (usually under 50mA)
- RWU designs require an increase in this auxiliary supply to an optimal level of 720mA
- RWU designs are simplified if there is a supply valid signal provided for Main and Aux power
- There are a number of existing connectors for RWU
  - Different RWU solution providers use different connectors
  - Intel helped define single 3 pin connector as an industry standard (see spec in CD)

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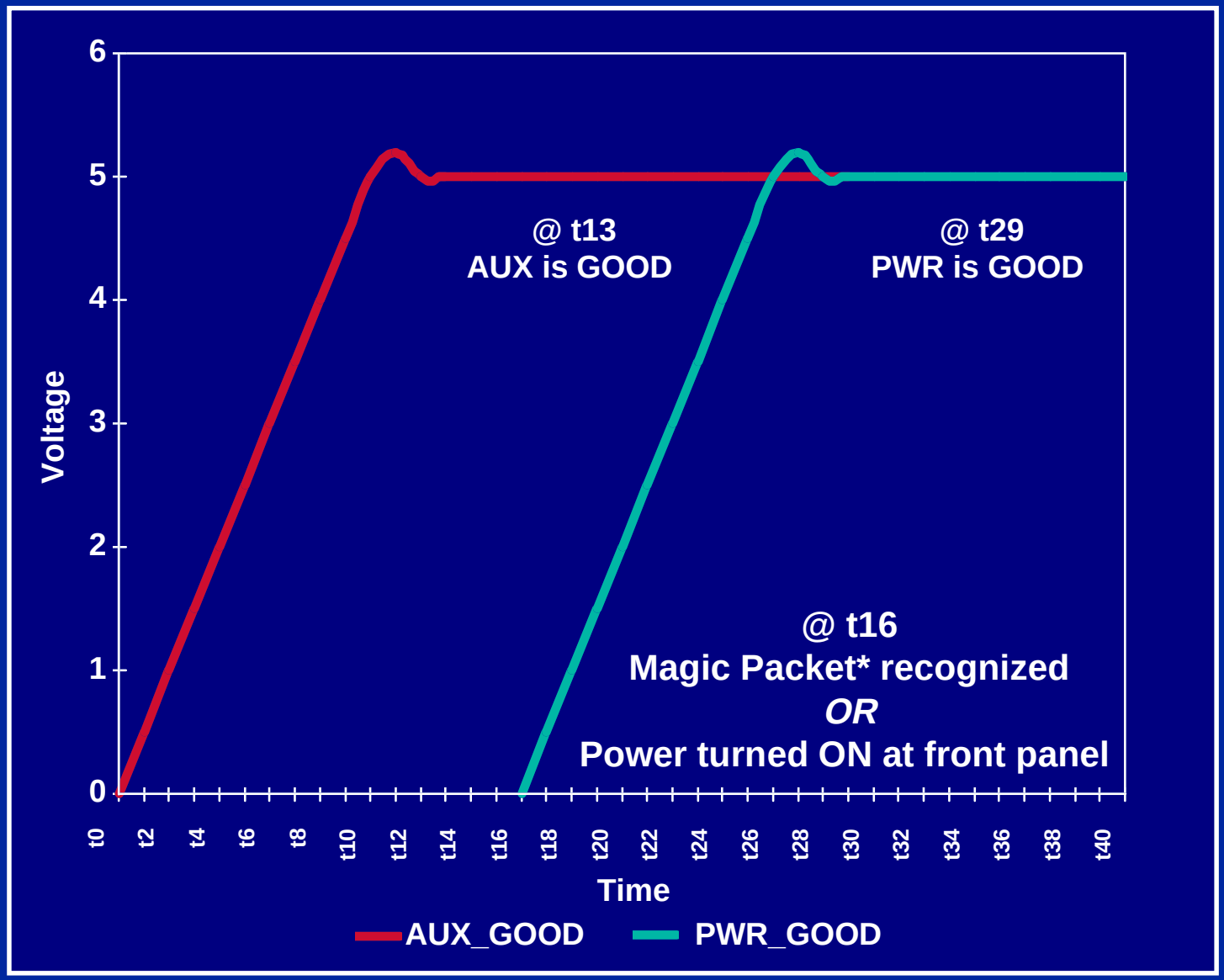
Power Supply Characteristics



RWU Planes and State Indicators

- Aux and Main power planes
- Auxgood and PWRgood indicator circuits
- 82557 isolation circuitry and its integration into the 82558
- Avoid Plane bleed-thru and component damage
- FET switching between planes to support all modes

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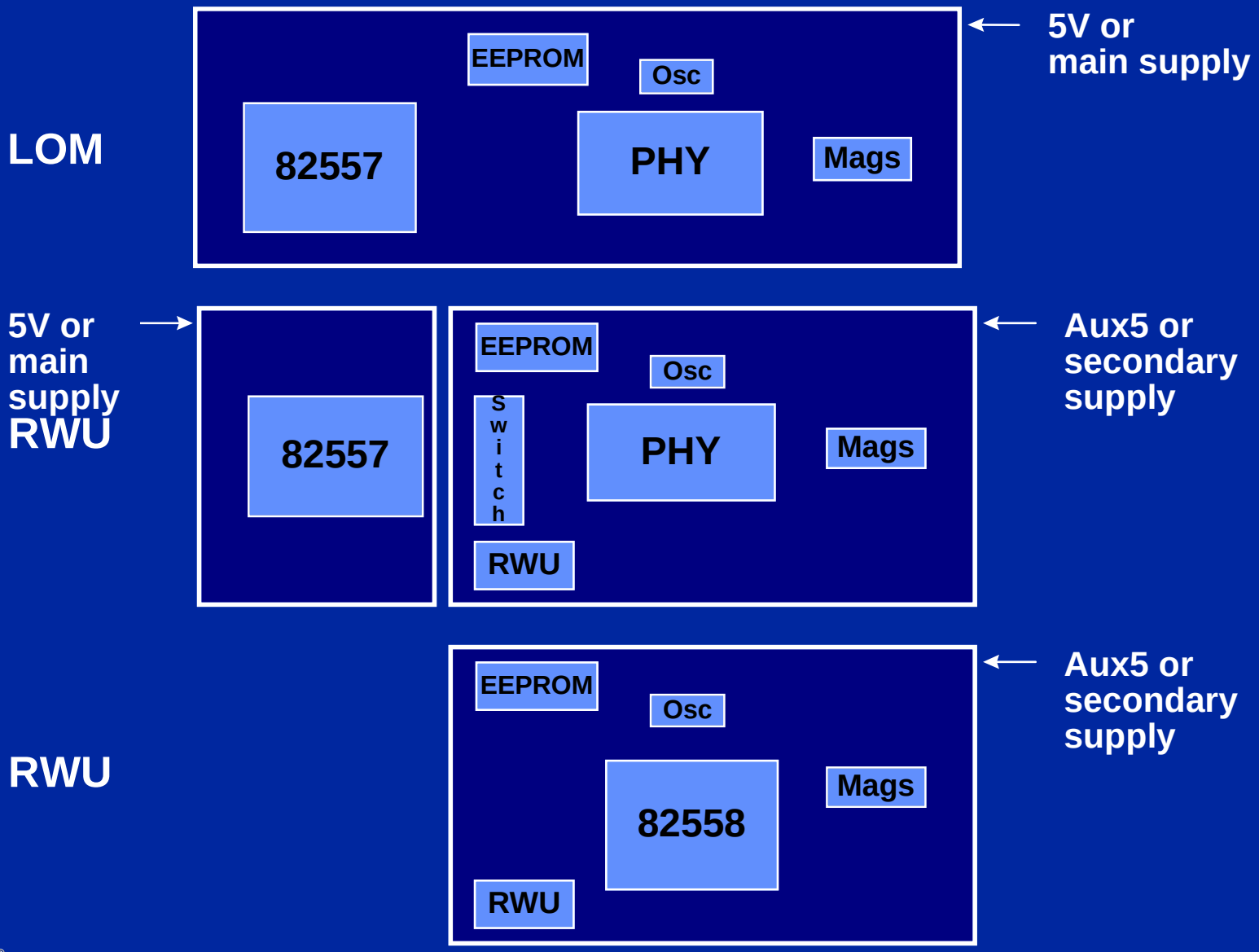
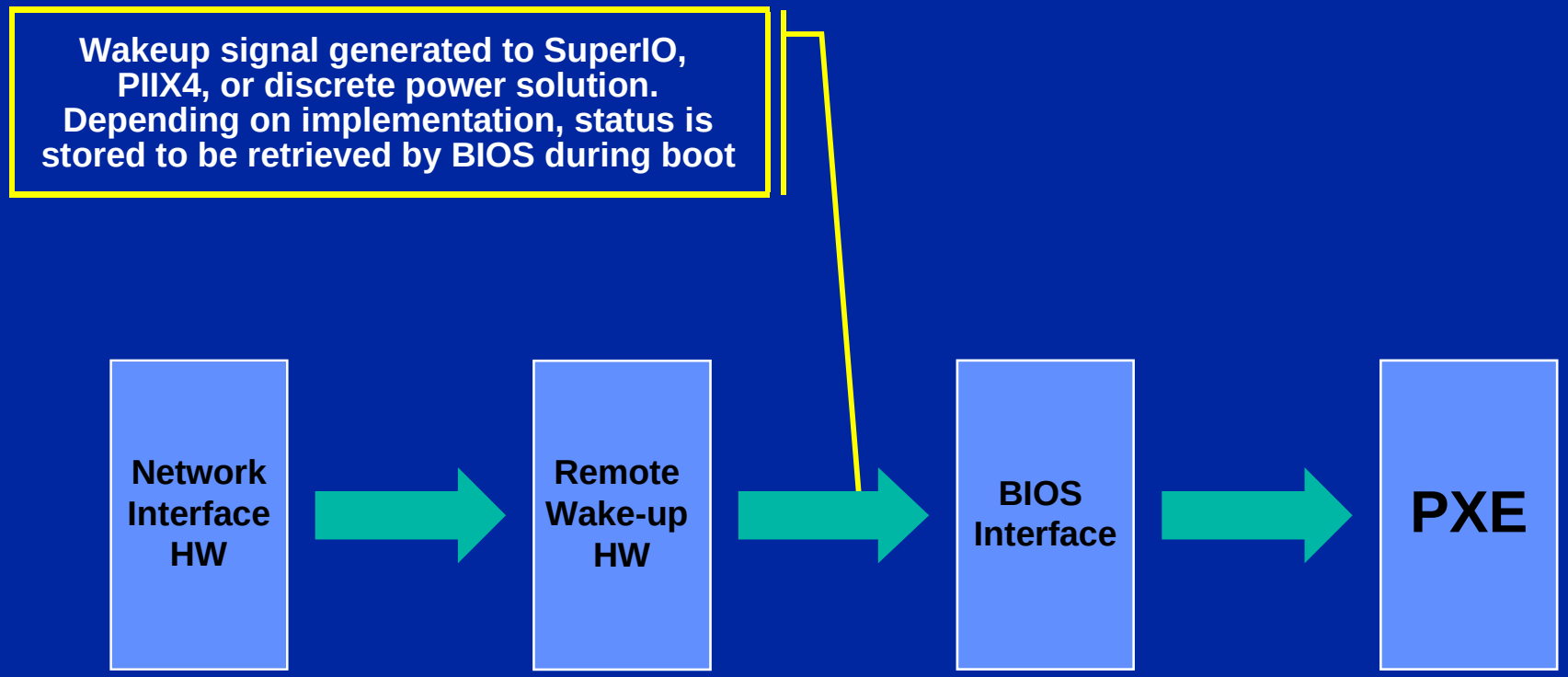
LOM and RWU Power Planning



Remote Wake-up



Wakeup Signal Receiver Circuits

- Implementations:
  - Power supply switch
    - Not forward compatible
    - Not configurable to disable or get status
  - SuperIO ring indicator
    - Exists in current designs already
    - Configurable and Status friendly
  - PIIX4 ring indicator
    - Exists in current designs already
    - Configurable and Status friendly

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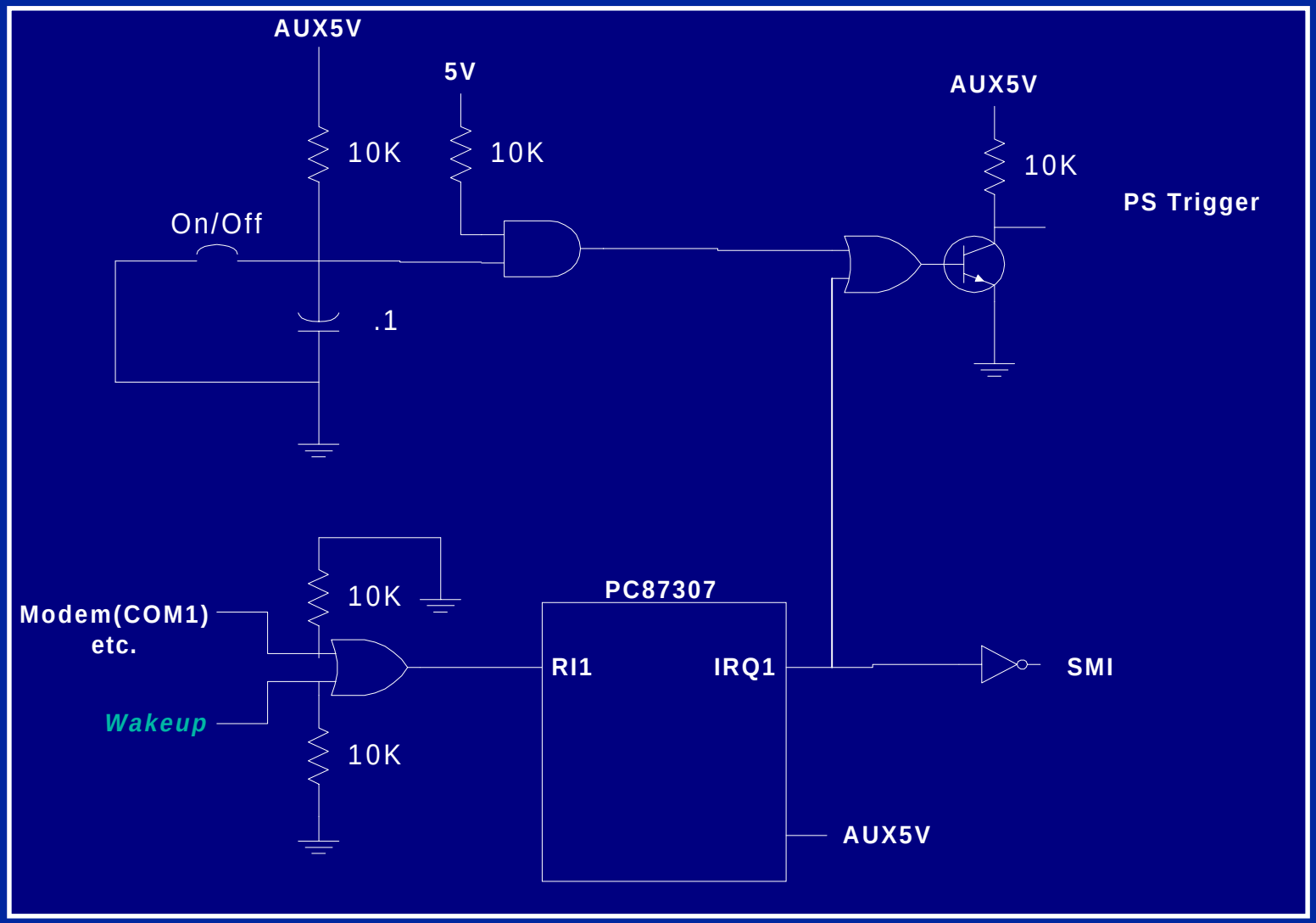
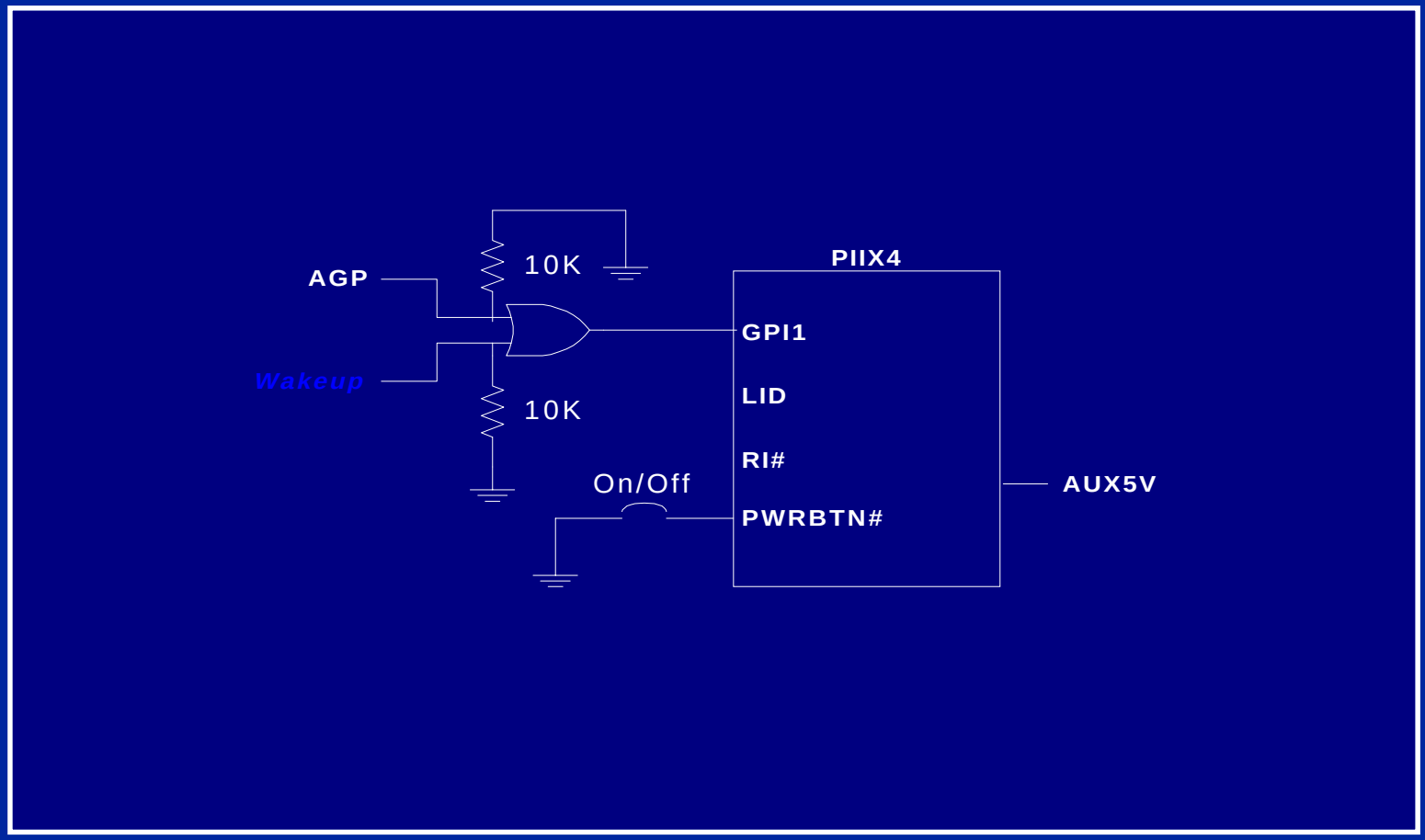
SuperIO



PIIX4



RWU Testing and Validation

- False packets (15 IAs, 5 “FF”s, etc.)
- Marginal voltage level testing
- High network traffic behavior
  - RWU
  - Normal LAN
- Power cycling behavior
- IPSL segment will give greater detail

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BIOS Hooks

- Stores the occurrence of a wake event for post-boot use
- Allows control of what functionality provides RWU functionality (LAN, modem, etc.)
- BIOS section will cover in more detail

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```
Determine Source of Current Wake-Up
               Enter:
                    AX := 2307h
                    BX := 5755h
                    Int 15h
               Exit:
                    CY := 0 (Success)
                    AH := 00h (Success)
                    CL (bits 2-0) := 6 (Power Switch)
                    CL (bits 2-0) := 5 (LAN)
                    CL (bits 2-0) := 4 (COM1 RING)
                    CL (bits 2-0) := 3 (Timer)

                    CY := 1 (Failure)
                    AH := 86h (Unsupported function)

                    All other registers are unchanged.

Set Source of Next Wake-Up
               Enter:
                 AX := 2308h
                 BX := 5755h
                 Int 15h
          Exit:
               CY := 0 (Success)
               AH := 00h (Success)
               CL (bits 7-3) := Unchanged from Determine Source of Wake-up
               CL (bits 2-0) := New wake-up source (see above)

                  CY := 1 (Failure)
                  AH := 86h (Unsupported function)

                  All other registers are unchanged.
```

Networking Support Model

- Don’t be an alpha site for first LOM designs -
  - Intel is currently supporting their third generation of successful 10/100 designs (with the 82558)
- Make sure they have top of the line SW -
  - Intel is the market segment share leader in 10/100 solutions
- Make sure they can meet demand

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Networking Support Model

- Make sure they provide competitive and timely solutions -
  - Intel provides high performance/low cost workgroup components (hubs, switches, downlinks, etc.)
  - Intel is developing and providing next - generation network manageability solutions

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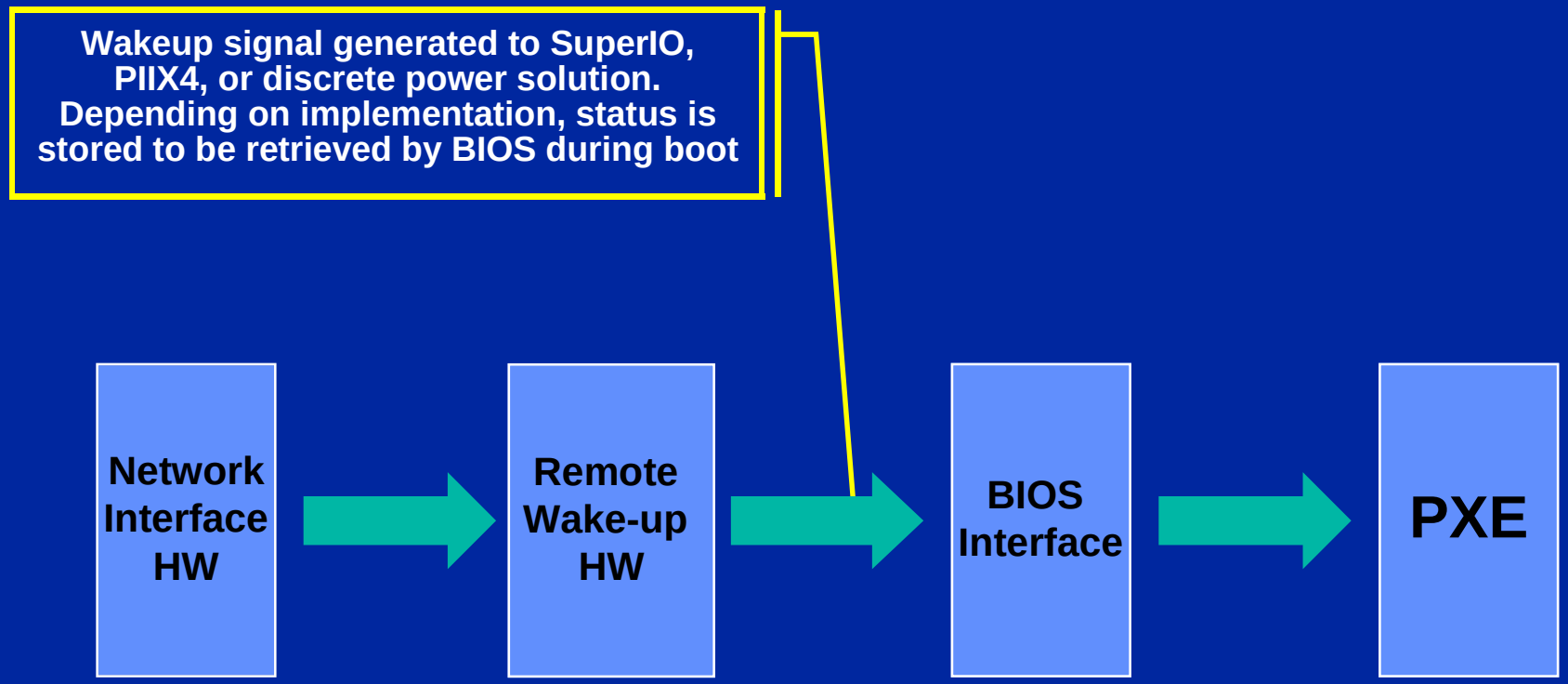

Summary

- RWU is a fundamental building block of WFM.
- LOM is simpler path to RWU
- RWU is easy if guidelines followed
- Choose networking vendor carefully

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Collateral

- Wired for Management Baseline
- Wake-On-LAN (WOL) Header Recommendations
- Intel 82557 Fast Ethernet PCI Bus LAN Controller Data Sheet
- Wake On LAN Design Guidelines
- Intel 82558 Fast Ethernet LAN Controller with Integrated PHY

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Backup

LOM/WOL Milestones

- Collateral provided
- First schematics/layout provided
- First schematics/layout reviewed
- First units provided
- First units IEEE and functional test
- Design adjustments made
- FCS units provided
- FCS unit IEEE and functional test
- Certification

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When Certification is Needed

- HW and EMI/Environment
  - When the PBA rolls (the schematic has changed and a new layout generated)
- SW
  - When the executable size and date change (run-time code changes have occurred)

Engineering Support

- Multiple Support Channels
  - 1-800 Intel Applications Support
  - Factory TME Support
  - Factory Application (NIC) Design Engineering Support
  - Chip Design Engineering Support

Network Functional Tests

- Flash presence
- Test and program EEPROM with ENET
- Init and configure MAC
- Test Interrupts
- 10 and 100 MBit line speed configure
- Autonegotiation test
- 10 and 100 MBit internal loopback test
- 10 and 100 MBit PHY loopback test
- 10 and 100 MBit board to board function test
- Confirm EEPROM ENET value

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General PHY Characteristics

	Avail	Speed	FDX	Driver Support	Power	# chips	Interface
82558	Now	10/100	Yes	Yes	230mA	1	MII
82555	Now	10/100	Yes	Yes	275mA	1	MII
ICS1890	Now	10/100	Yes	Yes	360mA	1	MII
83840	Now	10/100	Yes	Yes	560mA	2	MII

Generic BOMs for PHY implications

82558 BOM	82555 BOM	1890 BOM	83840 BOM
20 resistors	14 resistors	21 resistors	42 resistors
7 capacitors	9 capacitors	5 capacitors	8 capacitors
1 crystal	1 crystal	1 crystal	2 crystals
3 LEDs	2 inductors	3 inverters	4 transistors
Mags	3 LEDs	3 LEDs	3 LEDs
	Mags	Mags	Filter