
HI-SPEED
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USB
TM

USB 2.0 Debug Port

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Agenda

- USB 2.0 Debug Port
- USB Debug Device
- Software Components
- Development Status

What Is the Debug Port?

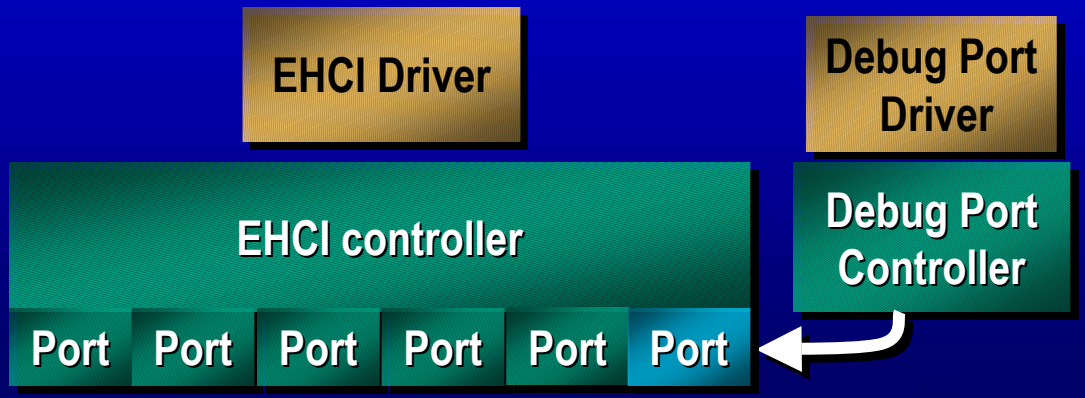
- Optional EHCI feature , details in Appendix C of the EHCI Spec, starting with Revision 0.96
- A simple means of performing single transactions: “pseudo-PIO” USB
- Only works with High-Speed USB devices
- Implemented for a specific port, optionally more
- Operational if port is not suspended and the HC is fully powered

Why Is It Needed?

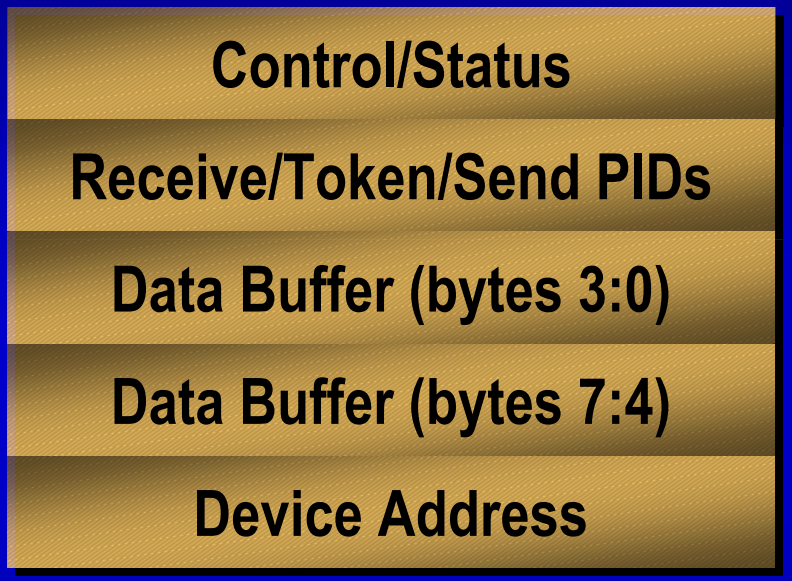
- PC2001 System Design Guide requires debug capabilities in all systems
- Low-cost solution for legacy free debugging
- Low operation complexity = Reliability & Stability
- 5x higher data rate than Super I/O & LPC solutions

Debug Port Architecture

- Debug port provides a memory mapped interface that is independent of EHCI controller
  - Memory space is typically mapped in same area as EHCI
  - Identified and located through ‘PCI capability’ mechanism



Memory Interface



- All registers are dwords
- Registers are located in same memory area as standard EHCI registers
- Debug port capability and register location is determined through PCI Extended Capabilities features

Operational Model

- For OUT transaction:
  - SW initializes token PID to OUT, data PID to DATAx, and puts appropriate data in the data buffer
  - SW tells HW to begin, HW sends token packet and data packet, then waits for handshake packet.
  - HW updates registers with status
  - SW checks status - If no error, SW checks received PID
- For IN transaction
  - SW initializes token PID to IN, and starts the HW
  - HW sends token packet, waits for DATAx packet, and responds with handshake packet if everything OK
  - HW updates registers with status and received length
  - SW checks status - if no error, SW checks PID, gets data

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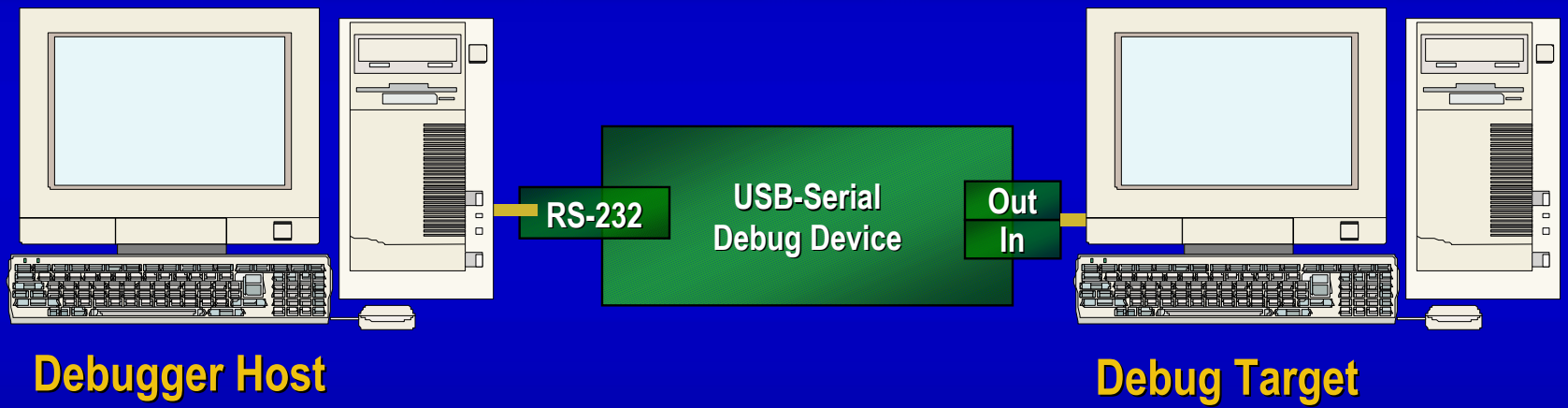
USB Debug Device



USB to Serial Debug Device Example

USB Debug Device

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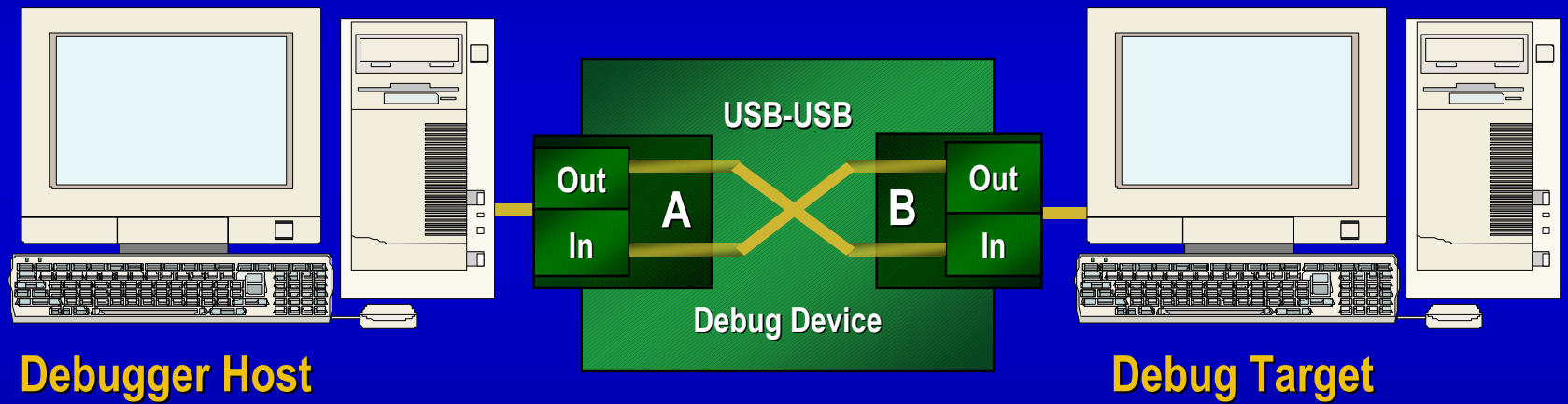
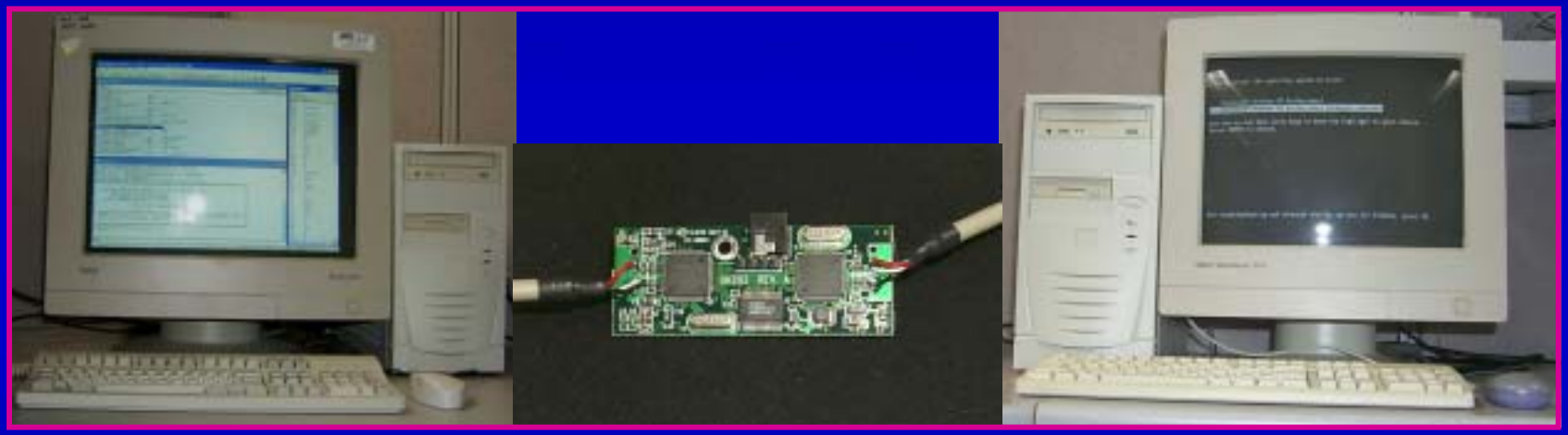


USB to USB Debug Device Example

USB Debug Device

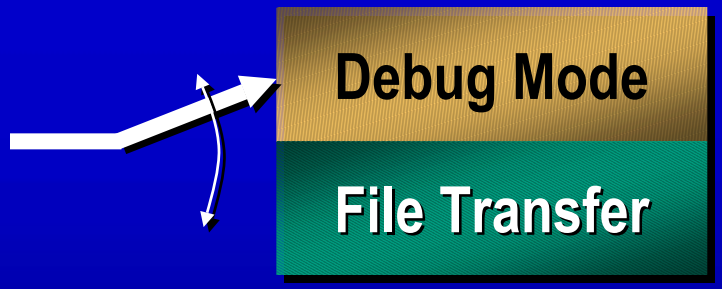


USB to USB Debug Device Example

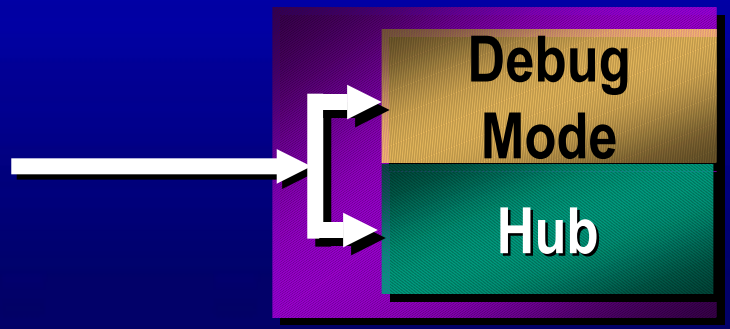
Debug Device Types

- **Fixed Function**
  - Dedicated - only a debug device
  - Has hard-coded address of 127

- **Single Function**
  - Works as a debug device OR as another type of device



- **Multi-function**
  - Combines a fixed-function debug device with another device, a hub for example



Debug Device Requirements

- Must be USB 2.0 High-Speed signaling compliant
- Debug Port Supports Maximum Packet Size of 8, so
  - One bulk-type IN endpoint supporting a maximum packet size of 8 bytes
  - One bulk-type OUT endpoint supporting a maximum packet size of 8 bytes
  - The Control Endpoint must correctly handle short transfer requests of 8 bytes
- Must support Debug Device extensions
- If device has a fixed address, that address must be 127

Debug Device Extensions

Two Extensions for Debug Devices:

- DEBUG Descriptor Type
- DEBUG MODE Feature Selector

Debug Device Extensions

- DEBUG Descriptor Type
  - Provides means of detecting Debug Device functionality
  - Valid from default, addressed, and configured states
  - Provides Target-platform with operational params in < 8 bytes
    (Remember, Debug Port = 8 byte max transfers)

Offset	Field	Value	Description
0	bLength	Number	Length of this Descriptor in bytes: 4
1	bDescriptorType	Constant	DEBUG descriptor type
2	bDebugInEndpoint	Number	Endpoint number of Debug Data IN endpoint
3	bDebugOutEndpoint	Number	Endpoint number of Debug Data IN endpoint

Debug Device Extensions

- DEBUG MODE Feature Selector
  - Tells device to begin “debug device” operational mode
  - Used with SET_FEATURE request
  - Valid only from Default and Addressed state
  - Implied SET_CONFIGURATION request - allows Target to configure device without parsing configuration / interface / endpoint descriptors

bmRequestType	bRequest	wValue	wIndex	wLength	Data
00000000B	SET_FEATURE	DEBUG MODE	0	0	None

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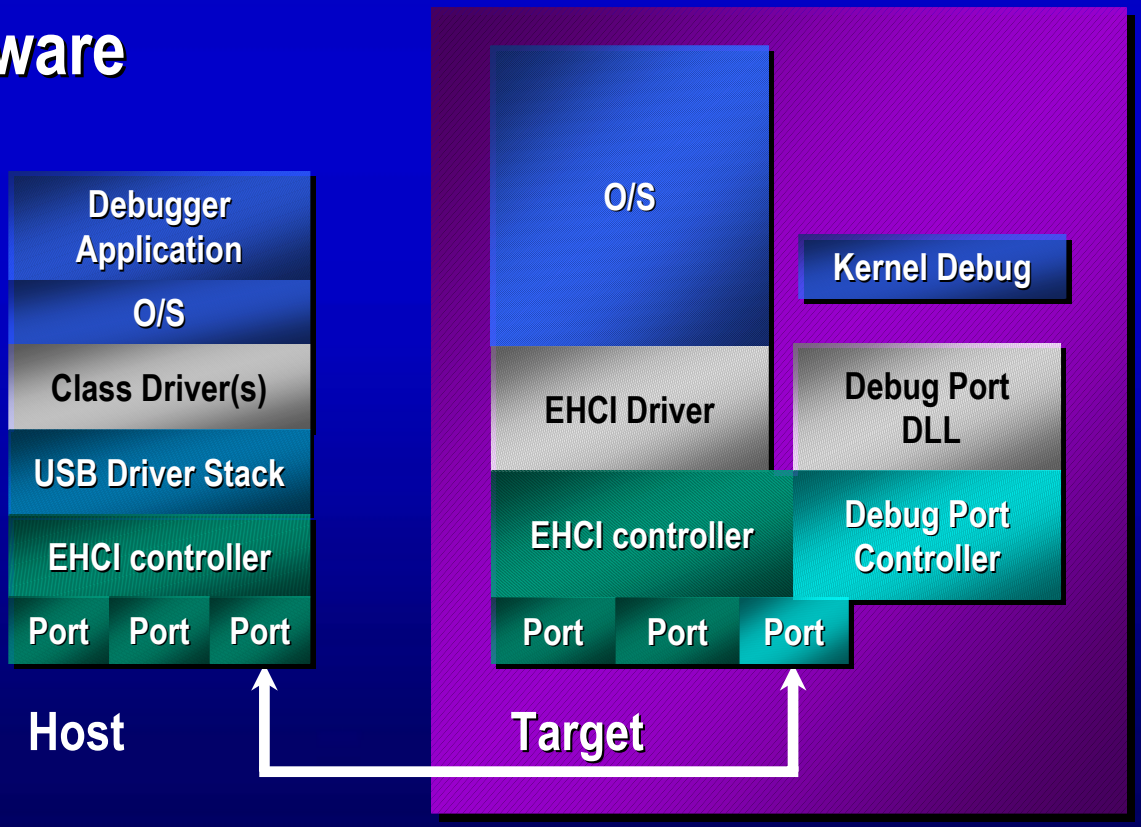
Target SW Components

- Target Platform Components
  - Debug Port DLL
  - Debug Port-aware EHCI driver



Debug Port DLL

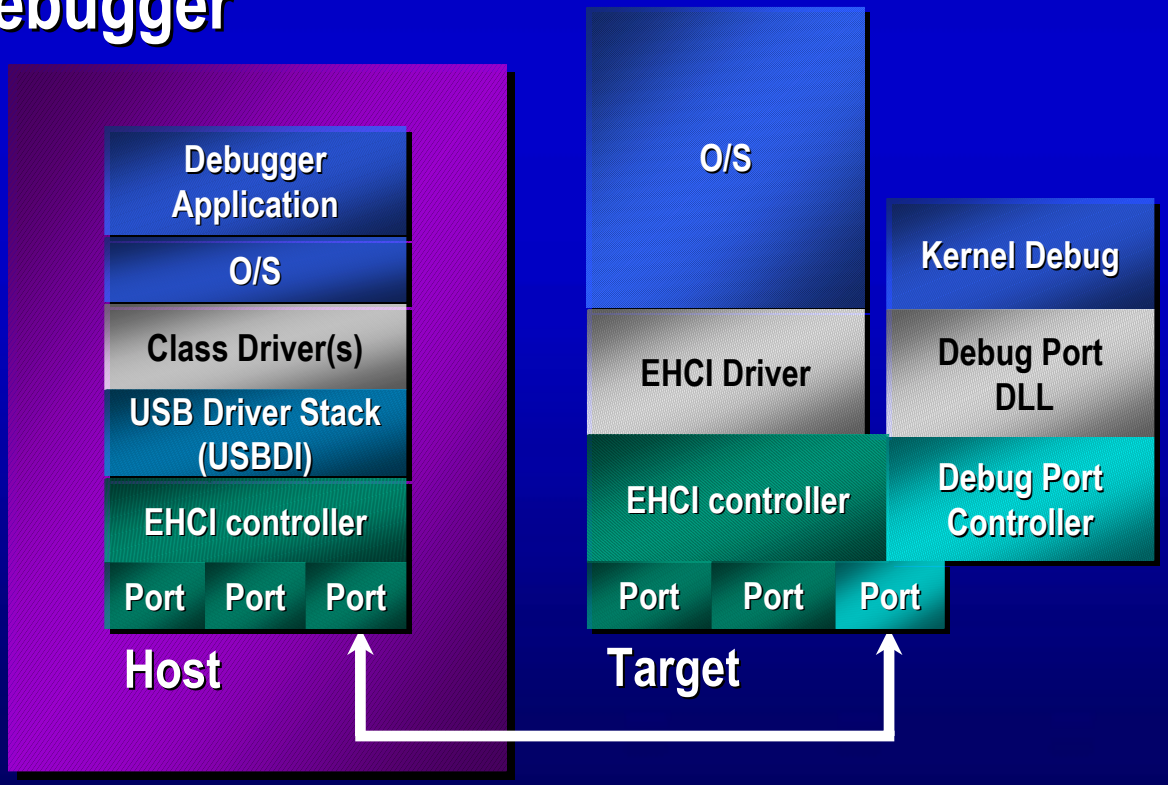
- Connects Kernel Debugging to the USB 2 Debug Port
- Loaded from BOOT.INI
  - DEBUGPORT=USB - O/S Loader loads kdusb.dll
- If device connected to Debug Port:
  - Reset Port
  - Send Get Descriptor:DEBUG descriptor type request to device
  - If device returns descriptor
    - Set device address (typically 127)
    - Send Set Feature:DEBUG MODE request to device to set configuration
    - Sets OWNER and IN-USE bits in Control/Status register to inform EHCI driver that debug port is in use

Debug Port-Aware EHCI Driver

- Cooperates with Debug Port DLL
- Examines Debug Port Control/Status OWNER and IN-USE bits at init time
- If OWNER / IN-USE set:
  - Does not reset host controller
  - Does not include Debug Port in Root Hub ports (Debug Port not available for general use)
  - Does not reset or suspend Debug Port
  - Does not respond to Debug Port status

Debugger Host SW Components

- Debugger Host Platform Components
  - Class Driver(s) that connect USB driver stack to Debugger



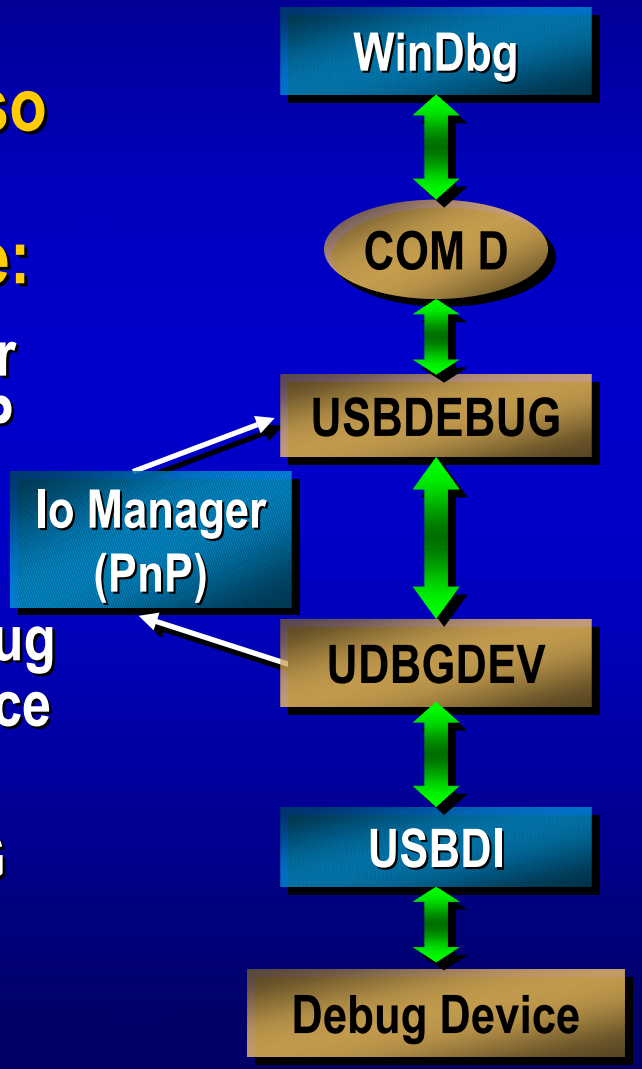
Current WinDbg Solution

Right now WinDbg doesn't know USB, so we use two drivers to create a virtual serial port from the USB debug device:

1) USBDEBUG.SYS creates a Device Object for the virtual serial port (COM D), Waits for PnP to announce arrival of a Debug Device interface

2) UDBGDEV.SYS is a PnP driver for USB Debug Devices. It registers a Debug Device interface with PnP when Debug Device appears

3) WinDbg opens COM D, causing USBDEBUG to open UDBGDEV



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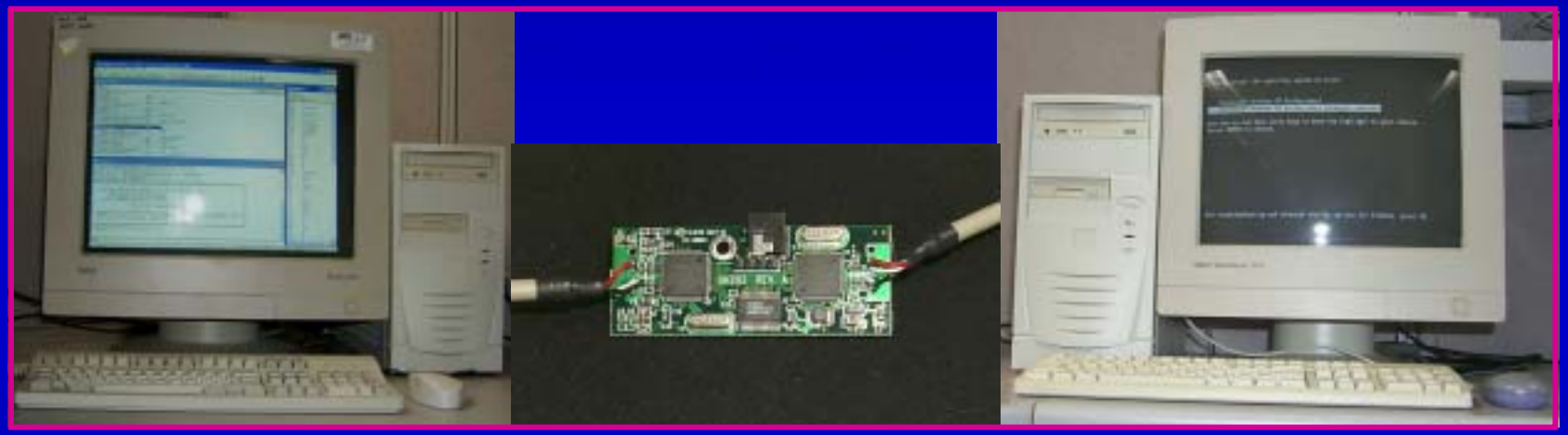
Development Status

- Debug Port Implemented in ICH4 Chipset, other vendors nearing completion of Debug Port implementations
- Prototype USB-to-Serial & USB-to-USB Devices Done
  - Netchip has working USB-to-USB reference design for OEMs

- Prototype Software Components Complete
- Intel is working with Microsoft on:
  - Debug Port DLL and Debug Port-Aware EHCI Miniport
  - Deployment Strategy

Demonstration



USB to USB Debug Device

Summary

- USB 2 Debug Port allows kernel debugging on legacy free systems, a viable alternative
- Ingredients coming together nicely: Host controllers, Debug devices, Target software, and Remote software

Call To Action

If you want USB debugging, let Microsoft know how much you want it

Collateral

Available from http://developer.intel.com/technology/usb/spec.htm:

- Enhanced Host Controller Interface Specification for Universal Serial Bus
  Revision 0.96 and 1.00
- USB2 Debug Device - A Functional Device Specification
  Revision 0.9