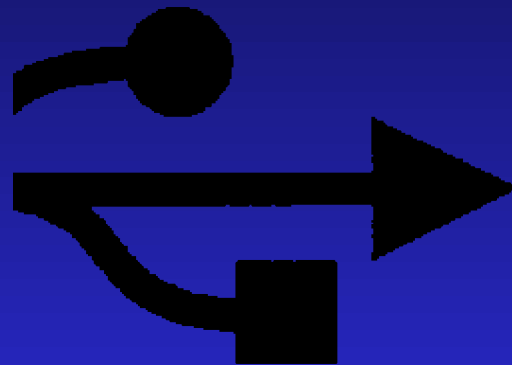




Keil Software Presents

USB



Universal Serial Bus

CM Research

Prepared This Seminar
Exclusively for Keil Software, Inc.

(800) 262-1CMR

(281) 326-3601

www.cmresearch.com



Development Tools for the 8051, 251, and 166

Keil is the only software vendor who is a member of
the USB Implementers Forum

(800) 348-8051

www.keil.com

Seminar Topics

- **What is USB?**
- **Why is USB important?**
- **How does USB work?**
- **How to build a USB device!**
- **End-to-End USB Demonstration!**

What is USB?

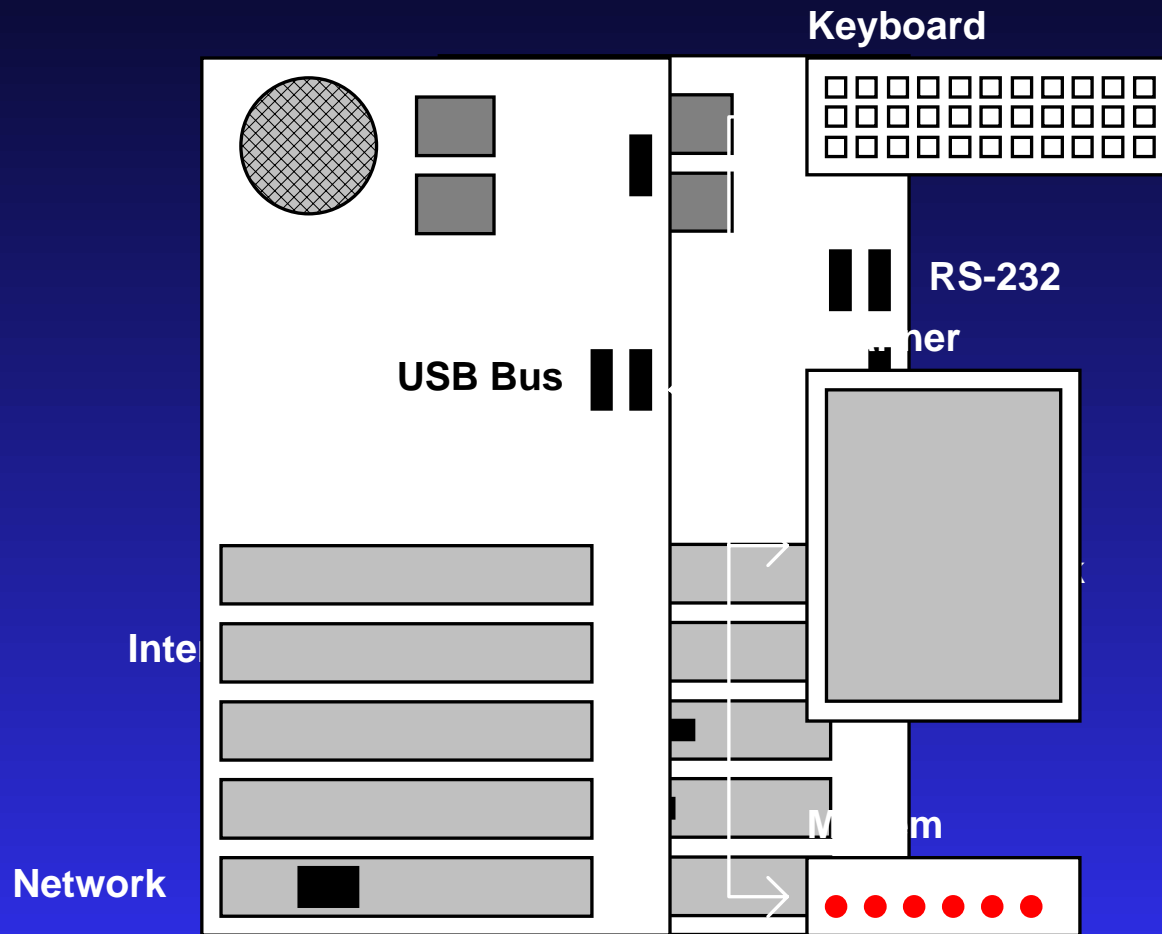
Why is USB important?

- External serial bus for PC peripherals
- Easy to Use - truly “Plug and Play”
- Allows “Hot Plugging”
- Allows 127 devices on the bus... **Simultaneously!**
- 12 Mb/s bandwidth
- Supports both Isochronous and Asynchronous data transfers
- Bus powered devices
- Industry acceptance

Typical USB Devices

- ◆ Human Interface Devices
 - ◆ Joysticks
 - ◆ Mice
 - ◆ Keyboards
- ◆ Image Devices
 - ◆ Cameras
 - ◆ Scanners
- ◆ Communications Devices
 - ◆ Faxes
 - ◆ Modems
- ◆ Audio Devices
 - ◆ Speakers
 - ◆ Telephones
- ◆ Printer Devices
 - ◆ Printers
 - ◆ Any IEEE 1284 Device
- ◆ Storage Devices
 - ◆ Floppy Drives
 - ◆ CD-ROM Drives
- ◆ USB Hubs

Typical USB System



Obtaining USB Devices

◆ **Keyboards:**

| | | |
|-----------------|----------|---|
| BTC | BTC-7932 | http://www.btc.com.tw/ |
| Cherry Electric | G81-3504 | http://www.cherrycorp.com/ |

◆ **Mice:**

| | | |
|--------|--------|---|
| Genius | GMOUSE | http://www.genius-kye.com/ |
|--------|--------|---|

◆ **Cameras:**

| | | |
|-----------|-------------|---|
| Connectix | QuickCam VC | http://www.quickcam.com/ |
| Kodak | DVC 323 | http://www.kodak.com/ |
| Quetech | SmartVue | http://www.quetech.com/ |

USB Stuff

<http://www.usbstuff.com/>

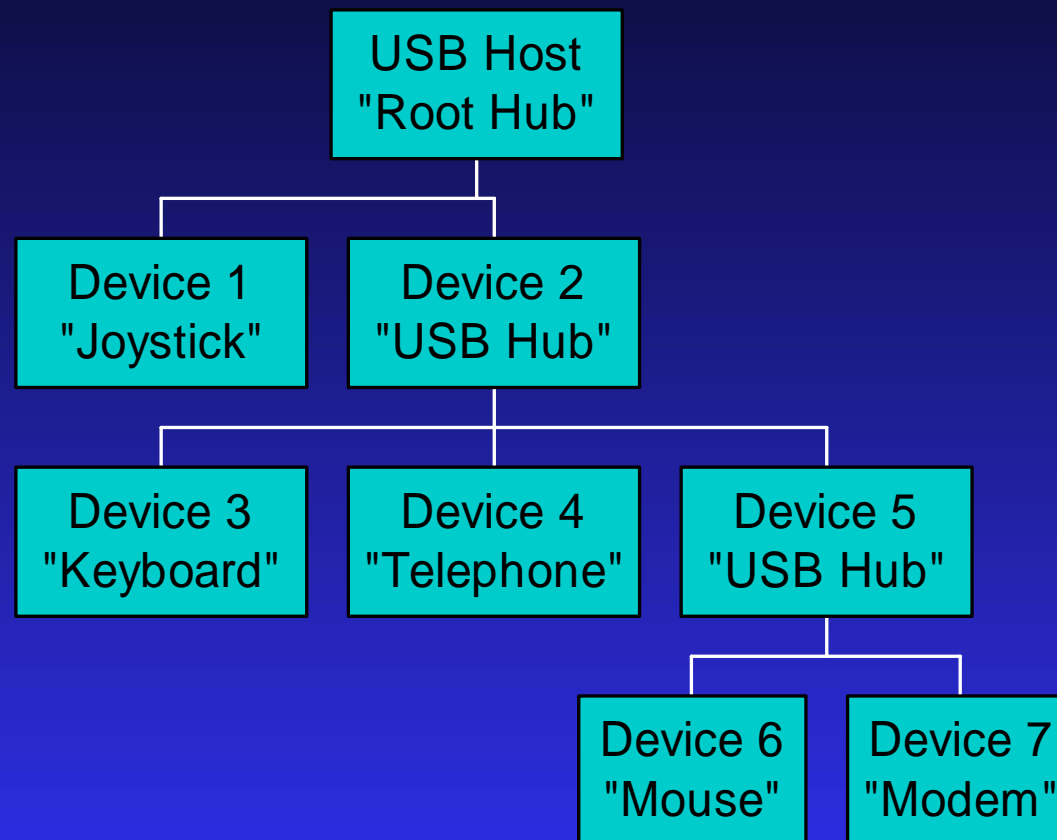
(888) 728-7287

How does USB work?

Topics

- Bus Topology
- Data Transactions
- Descriptors
- Enumeration
- Classes

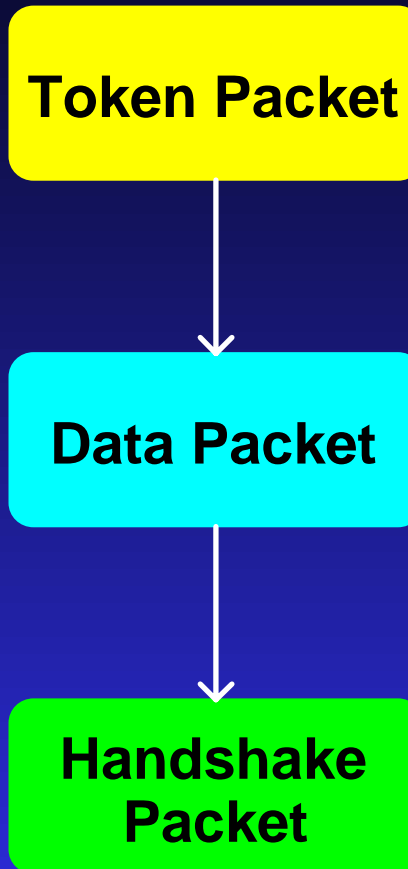
Bus Topology



Types of Data Transactions

- ◆ **Control**
 - ◆ Controls the bus
 - ◆ Bi-directional
 - ◆ Setup, Data, & Status
- ◆ **Interrupt**
 - ◆ Receives data at timed intervals
 - ◆ Input Only
 - ◆ 1-255 ms intervals
- ◆ **Isochronous**
 - ◆ Time critical data, no CRC
 - ◆ Uni-directional
 - ◆ Up to 1023 bytes per frame
 - ◆ Guaranteed bandwidth per frame
- ◆ **Bulk**
 - ◆ Asynchronous data, CRC
 - ◆ Bi-directional

USB Transfers



USB Packets

Packet Identifier
Control: OUT, IN, SOF, SETUP
Data: DATA0, DATA1
Handshake: ACK, NAK, STALL
Special: PRE



Synchronizes PLL

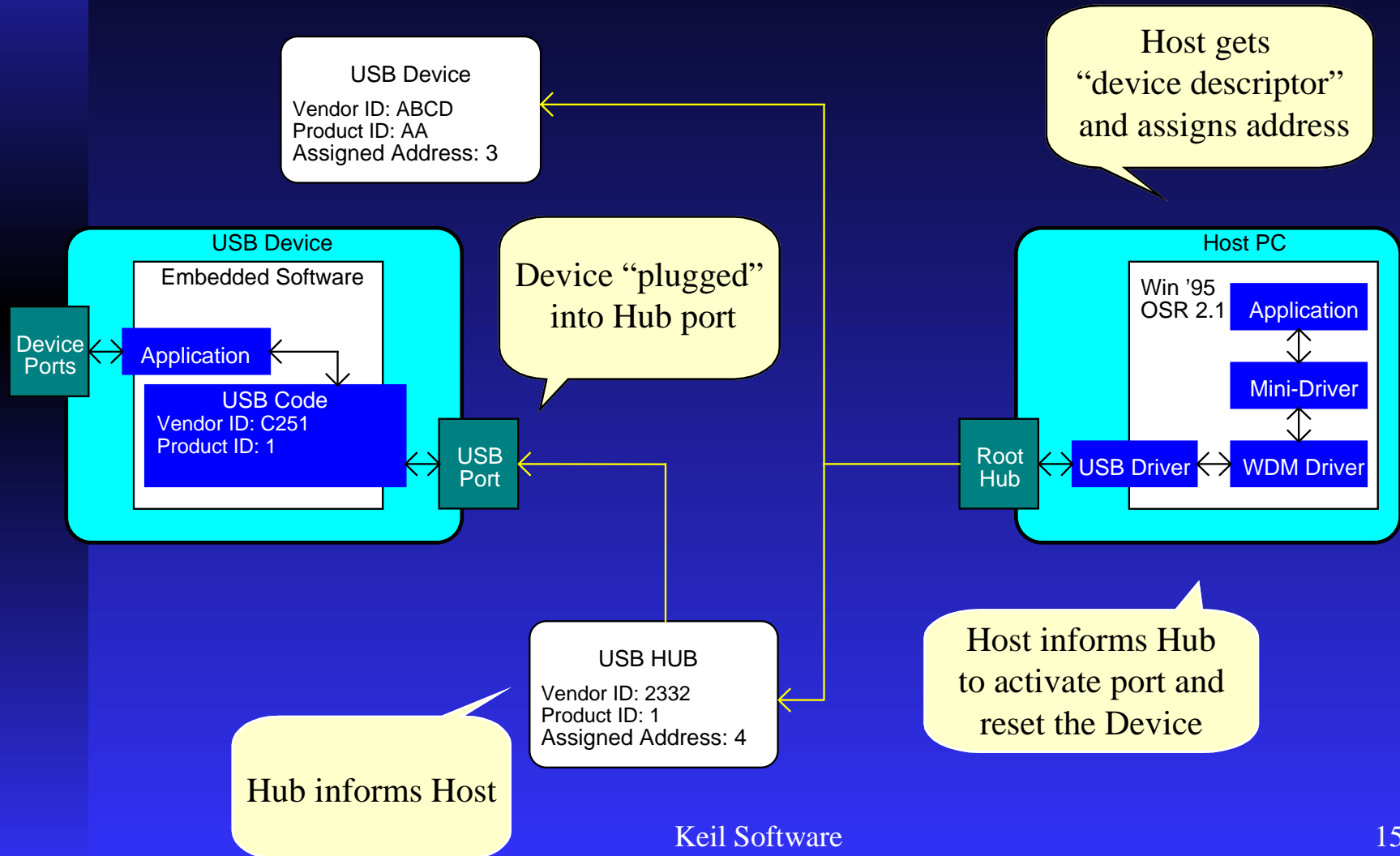
Data Field

Cyclic Redundancy Check

USB Descriptors

- ◆ Device Descriptor
 - ◆ Specification Release
 - ◆ Class Information
 - ◆ Device Protocol
 - ◆ Max Packet Size for EP0
 - ◆ Vendor ID
 - ◆ Product ID
 - ◆ Number of Configurations
- ◆ Configuration
 - ◆ Number of Interfaces
 - ◆ Device Attributes
 - ◆ Maximum Power
- ◆ Interface
 - ◆ Number of Endpoints
 - ◆ Interface Class
 - ◆ Interface Protocol
- ◆ Endpoint
 - ◆ Address of Endpoint
 - ◆ Direction of Endpoint
 - ◆ Attribute of Endpoint
 - ◆ Maximum Packet Size

Device Enumeration



USB Classes

- ◆ Audio Class
 - ◆ Speakers
- ◆ Communications Class
 - ◆ Modems
- ◆ Hub Class
 - ◆ Hubs
- ◆ Human Interface Device
 - ◆ Joysticks
 - ◆ Mice
- ◆ Image
 - ◆ Camera
 - ◆ Scanners
- ◆ Monitor
 - ◆ Monitor Controls
- ◆ Physical Interface Device
 - ◆ Force Feedback Joysticks
- ◆ Power
 - ◆ UPS
- ◆ Printer
 - ◆ Printer
 - ◆ IEEE 1284 Device
- ◆ Storage
 - ◆ CD-ROM Drive
 - ◆ Floppy Drive

How to Build a USB Device

A Check List

- ✓ Get a copy of the USB specification
 - ◆ <http://www.usb.org/developers/>
 - ◆ Keil USB CD-ROM
- ✓ Recommended books on USB that help summarize and explain the specification and implementation:
 - ◆ The USB Handbook by Jaff Kosar
 - ◆ Developing USB Peripherals by Wooi Ming Tan
- ✓ Become a member of the Microsoft Software Developer Network, and obtain the USB DDK, Win '95 OSR 2.1, and a USB example.

How to Build a USB Device

A Check List

- ✓ Obtain a PC that supports USB
 - ◆ Many pre-built systems now come with USB
 - ◆ PCI to USB peripheral card from SIC Resources
- ✓ If you plan to develop WDM drivers you will need to have a PC with the following:
 - ◆ Windows NT 4.0
 - ◆ Windows NT DDK
 - ◆ USB DDK
 - ◆ Win 32 DDK
 - ◆ Visual C++

How to Build a USB Device

A Check List

- ✓ **IMPORTANT! IMPORTANT! Write a specification!!!!**
Determine what you need from your product, and what it requires. Ask yourself these questions about your device:
 - ◆ Do I need Isochronous communications? Or will Bulk do?
 - ◆ Do I need to be polled every few milliseconds using Interrupts?
 - ◆ Will my device be self or bus powered?
 - ◆ Can my device be suspended for power control?
 - ◆ What about Low-Speed USB for my device?
 - ◆ Does my device fit within a class and use a class driver?
 - ◆ What USB microcontroller meets my criteria?

How to Build a USB Device

A Check List

- ✓ By all means, “**Don’t reinvent the wheel, purchase an evaluation board.**”
 - ◆ Intel has evaluation boards for the ‘930 and ‘931
 - ◆ Anchor Chips has an 8051-based evaluation board. Their package comes with all the working code you need for developing a USB device including a **USB HOST DRIVER!**
 - ◆ SMC and Siemens also have 8051-based USB solutions.
- ✓ Get all the example code you can. Here are a few sources:
 - ◆ <http://developer.intel.com/design/usb/swsup/>
 - ◆ <http://www.usb.org/developers/>
 - ◆ Windows NT DDK
 - ◆ Anchor Chips evaluation kit

How to Build a USB Device

A Check List

- ✓ Get a compiler for the chosen microcontroller. For all of the **C51** and **C251** based microcontrollers your best choice is Keil's development tools. More information and a **FREE fully functional evaluation copy** can be obtained at:
 - ◆ <http://www.keil.com/>
 - ◆ Keil USB CD-ROM
- ✓ Obtain a Vendor ID from the USB-IF
- ✓ Join the USB e-mail reflector at:
 - ◆ <http://www.usb.org/developers/>

How to Build a USB Device

A Check List

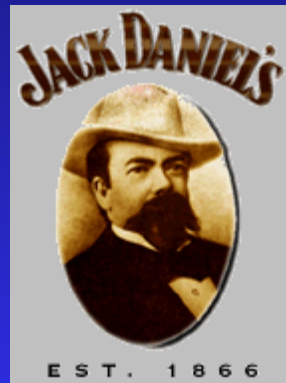
- ✓ Purchase other peripherals that might aid in development, including other USB devices. Here are some suggestions:
 - ◆ Bus analyzers
 - ◆ Hubs
 - ◆ Emulators
 - ◆ USB Mice, Keyboards, Cameras
- ✓ Write or “hack” the code for the:
 - ◆ USB Driver
 - ◆ MCU Firmware
 - ◆ Application

How to Build a USB Device

A Check List

- ✓ Attend a USB Compliance workshop. This will enable you to try your device on several different systems and configurations.

- ✓ Finally, get some Jack Daniel's or several hours of therapy.





Thank You

<http://www.keil.com/>