

***Introduction to
USB Development***

USB Development

- 1 Introduction
- 1 Technical Overview
- 1 USB in Embedded Systems
- 1 Recent Developments
- 1 Extensions to USB
- 1 USB as compared to other technologies

INTRODUCTION

USB: Universal Serial Bus

- 1 A serial bus standard for connecting devices usually peripheral devices to computers.

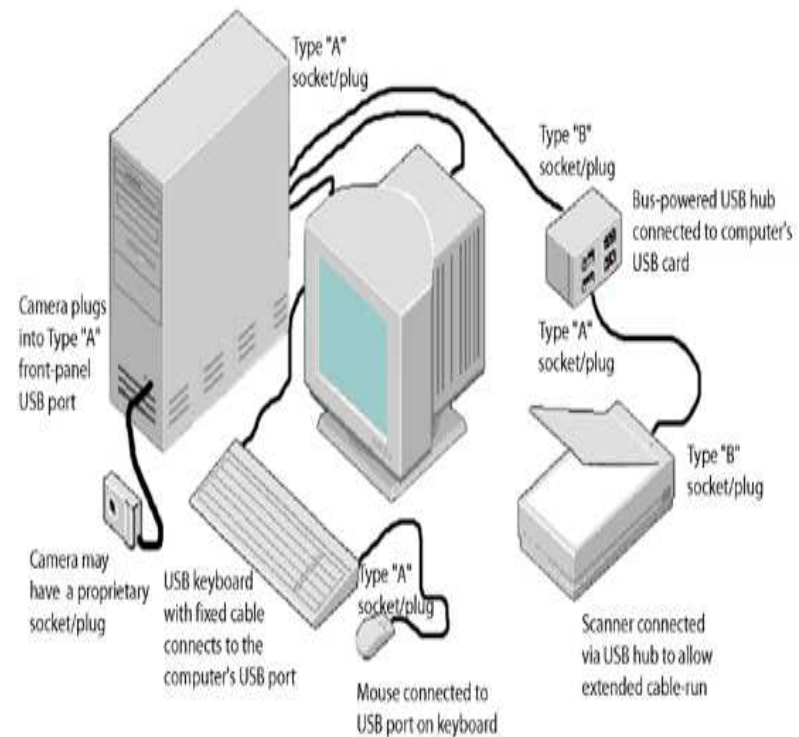
Need for USB

- 1 To eliminate a proliferation of the cables
- 1 Eliminate the need for plug in expansion cards

Standardization

- 1 Design of USB standardized by USB implementers forum

Why USB for Embedded Systems?



INTRODUCTION

USB:

- ┆ Offers simple connectivity
- ┆ Low cost
- ┆ Ease of use
- ┆ Manages power effeciently
- ┆ Supports all kinds of Data

TECHNICAL OVERVIEW

Serial Protocol and Physical Link uses two pairs of wires

- 1 Upstream Connection and Downstream Connection

Uses three types of cables and two types of connectors

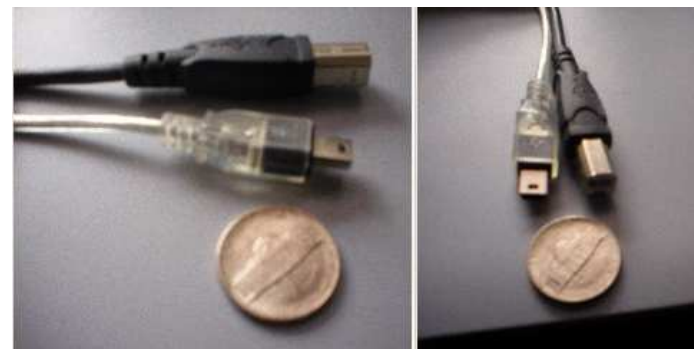
- 1 High Speed cables at 480 Mbps
- 1 Full Speed cables at 12 Mbps and
- 1 Low Speed cables at 1.5 Mbps

USB standard uses NZRI system to encode data

Types of connectors

Two Types of Connectors:

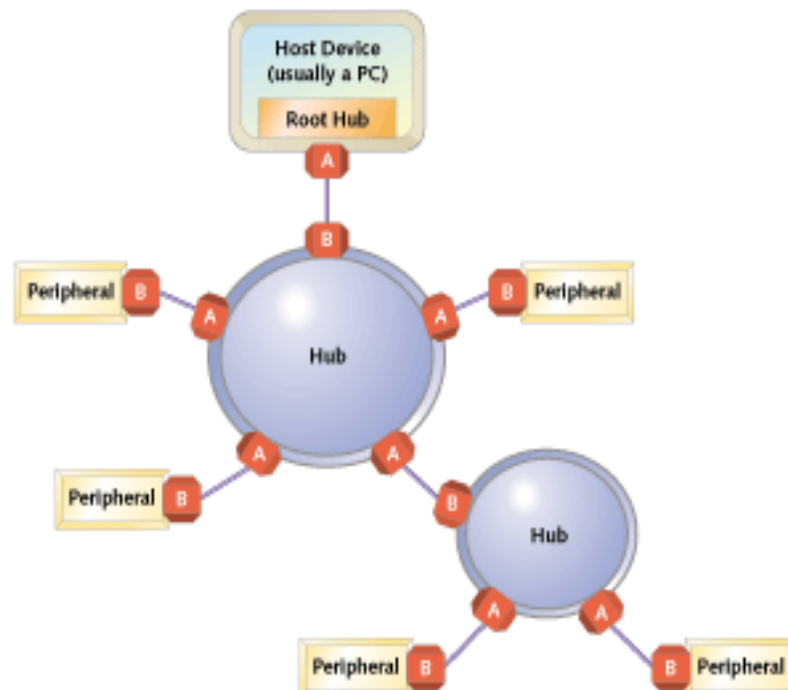
- 1 Type A
- 1 Type B



ARCHITECTURE

Architecture of a USB network

- 1 Consists of one host device and multiple daisy chained devices



ARCHITECTURE

Follows a Tiered star Topology and consists of:

- 1 Peripherals
- 1 Hubs
- 1 Host controller

Peripherals receive and respond to the commands from the host. E.g. Mice, Keyboard, Joysticks

Two types of Peripherals

- 1 Standalone and
- 1 Compound Device

ARCHITECTURE

- 1 Host recognizes the peripheral through a process called **Enumerations**
- 1 Host communicates with the peripheral to learn its identity and identifies which device driver is required
- 1 Host supplies the peripheral with an address

HUBS:

- 1 Allows many USB devices to share a single USB port
- 1 USB devices with some incorporated intelligence
- 1 Increase the logical and physical fan out
- 1 Single upstream connection and one-many down stream connection

ARCHITECTURE

Two kinds of Hubs:

- Bus Powered Hub: Draws power from the host computers USB interface
- Self Powered Hub: Has a built in power supply.

Smart wire passing data between the peripheral and Host

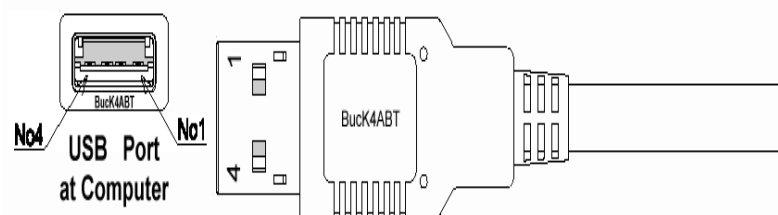
Direct connection exists between host and peripherals

Host is the controller of the entire network. E.g. PC



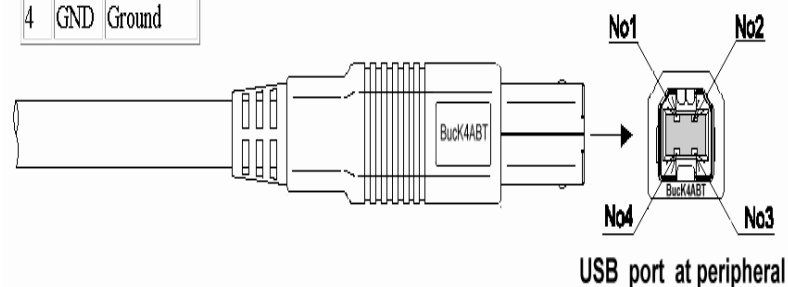
Power Management

- 1 Peripherals connected regardless of the power state
- 1 A pair of wires to supply power to the peripherals
- 1 Manage power by enabling and disabling power to devices
- 1 Removes electrically ill behaved systems from the network



Pin	Name	Description
1	VCC	+5 VDC
2	D-	Data -
3	D+	Data +
4	GND	Ground

Universal Serial Bus (USB)

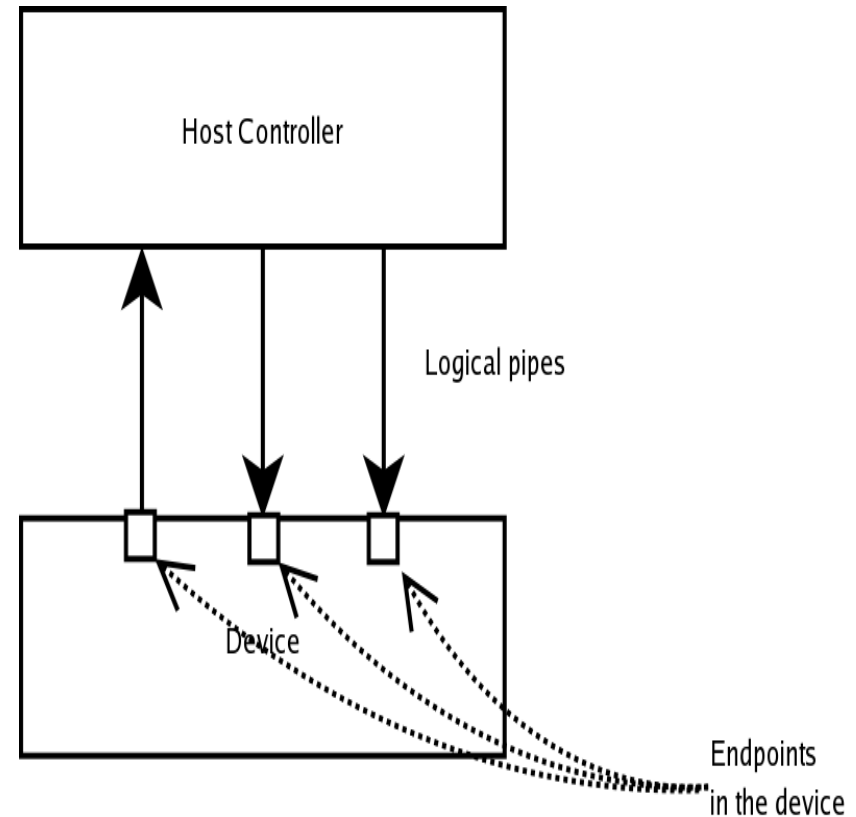


USB Communication Overview

- 1 Communication between the host and the end points located in the peripheral
- 1 End point is a unique point in the device which is the source or the receiver of the data
- 1 End point has a definite address associated with it
- 1 Codes indicate the type of transfer
- 1 16 end points within each device each end point has a 4 bit address
- 1 End point “0” reserved for control transfers

USB Communication Overview

- 1 Transactions between the host and end point take place through virtual pipes
- 1 Pipes are logical channels which connect the host to the end points
- 1 Once the communication is established the end points return a descriptor
- 1 Descriptor is a data structure tells the host about the end points configuration and expectations



USB Communication Overview

USB supports four transfer types of data:

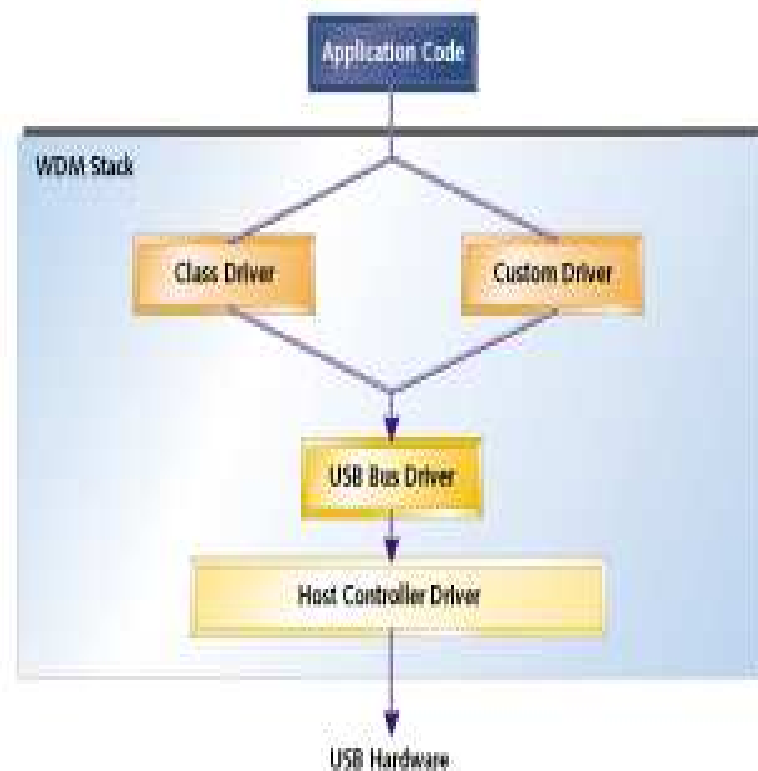
- 1 Control Transfers: exchange information such as configuration, command information , set up between host and end point
- 1 Bulk Transfers: Supports bulk amounts of data when timely delivery isn't critical.E.g. Printers and Scanners
- 1 Isochronous transfers: Handle transfers like streaming data
- 1 Interrupt transfers: Poll devices to see if they need service

HOST DEVICE DRIVERS

- 1 USB is a complex standard requires enormous amount of software support both of firmware side and the host support
- 1 USB communication model relies on the Win32 Driver model
- 1 Win32 driver model layers different processes of communication into a stack
- 1 Its organized into Application Layer, Driver classes, Bus Driver and Host controller driver

Host Device Driver

- Application Code reacts with the drivers using API calls
- Within the stack itself the communication is through Interrupt I/O request packets
- USB Bus driver manages Enumeration, power management and other USB transactions



Types of Drivers

1 Two types of drivers. Class Drivers and Custom Drivers

1 Drivers are organized into classes where hardware that falls into a single class share similar interfaces

E.g. HID Class which supports devices like mice, Joy sticks

Monitor class which supports image position, alignment

1 Custom Driver exploits capabilities of a particular piece of Hardware

E.g. A Data Acquisition system

USB in Embedded Systems

- 1 Processor based USB controller adding Keyboard and mouse to an existing design
- 1 USB Host controller will communicate with the existing design via an UART
- 1 Code for the Host USB controller will contain a Library of routines and an Application layer Firmware
- 1 Code from the Library will take care of enumerating newly attached or removed devices, communication to and from the devices, Memory management, etc.

USB in Embedded Systems

- 1 While creating the code the first step is to determine how many and what type of devices will be supported
- 1 The next step is to create application code for each device.
- 1 The driver template will include start, stop and run functionality
- 1 Addition of Hub Support is the key design consideration

EXTENSIONS TO USB

- 1 USB 2.0
- 1 PictBridge Standard to communicate imaging devices
- 1 Microsoft X box console
- 1 IBM Ultraport
- 1 USB 1.0 OTG
- 1 USB 1.0a supplement OTG
- 1 Wireless USB

USB On-the-Go Technology

- 1 USB On-The-Go Technology is used to provide dual role to the peripherals
- 1 Enables direct communication between the hosts without involving the processor
- 1 Incorporates Mini A , Mini B, Mini AB plugs and receptacles
- 1 Highly complex design

USB On The Go

Advantages:

- 1 Provides Dual Role Devices
- 1 Introduces new connector types, Mini A, Mini B, Mini AB
- 1 Provides with Aggressive Power Management

On the Go Functionality of the USB can be implemented:

- 1 Using a Full solution Approach
- 1 Using a USB microcontroller
- 1 Designing a custom IC

Wireless USB

- 1 A Paradigm developed by Cypress that allows devices to be connected but appear as if they are connected to the host over normal USB connectivity
- 1 Addresses many of the Design issues of Wireless networking
- 1 An evolution that relies on familiar and existing technologies
- 1 Desirable for point to point devices
- 1 Features of Wireless USB are its Ease of use, simple connectivity and conservation of the battery power

USB as compared to other Standards (USB Vs FireWire)

USB

- § Connects peripherals to the computers
- § Operates at low data rates
- § Cannot be intended to act as an internal bus for storage
- § Follows a tiered star topology
- § USB uses a speak when spoken to protocol
- § Relies on a single host to control the network

FireWire

- A technology to interconnect mass storage devices
- Has higher data rates
- Uses a repeater based topology
- Can connect with any node at a time
- Any capable node can control the network
- FireWire ports are expensive

REFERENCES

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QUESTIONS??

