Universal Serial Bus

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Content Overview

- History of USB
  - Overview
- Future of USB
  - USB 3.0
  - WUSB

Overview

- Key features of USB:
  - Low cost
  - Single connector type
  - Hot pluggable
  - Device handling
  - Cable power

USB

- USB 1.0 specification introduced in 1994
- USB 2.0 specification finalized in 2001
- Became popular due to cost/benefit advantage
  - Eg. IEEE 1394 – high bandwidth, high cost
- Three generations of USB
  - USB 1.0
  - USB 2.0
  - USB 3.0 and WUSB

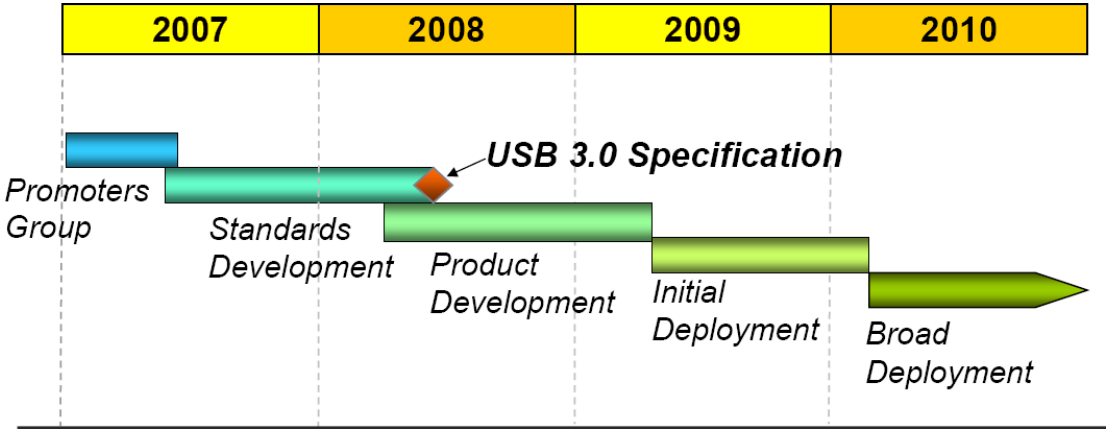
USB 3.0 Overview

- Also referred to as SuperSpeed USB
- Speeds 10x faster than 2.0 (5 Gbps in controlled test environment)
  - Transfer of 25 GB file in approx 70 seconds (see chart)
- Extensible – Designed to scale > 25Gbps
- Optimized power efficiency
  - No device polling (asynchronous notifications)
  - Lower active and idle power requirements
- Backward compatible with USB 2.0
  - USB 2.0 device will work with USB 3.0 host
  - USB 3.0 device will work with USB 2.0 host

	Song / Pic	256 Flash	USB Flash	SD-Movie	USB Flash	HD-Movie
	4 MB	256 MB	1 GB	6 GB	16 GB	25 GB
USB 1.0	5.3 sec	5.7 min	22 min	2.2 hr	5.9 hr	9.3 hr
USB 2.0	0.1 sec	8.5 sec	33 sec	3.3 min	8.9 min	13.9 min
USB 3.0	0.01 sec	0.8 sec	3.3 sec	20 sec	53.3 sec	70 sec

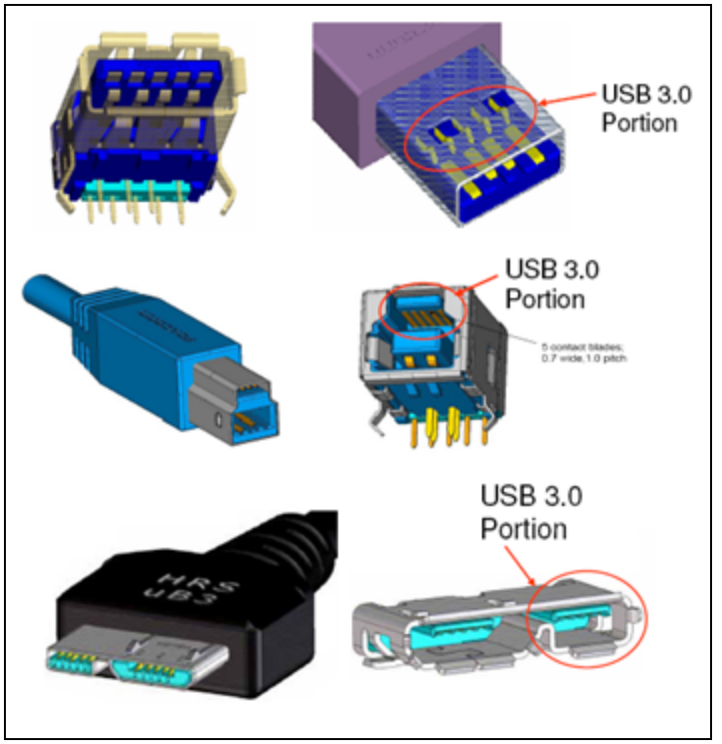
USB 3.0 - Timeline

- Promoter Group: Hewlett-Packard, Intel, Microsoft, NEC, ST-NXP Wireless and Texas Instrument
- Contributors Group contained over 200 companies (Nov 2007)
- USB 3.0 Specification became available Nov 2008



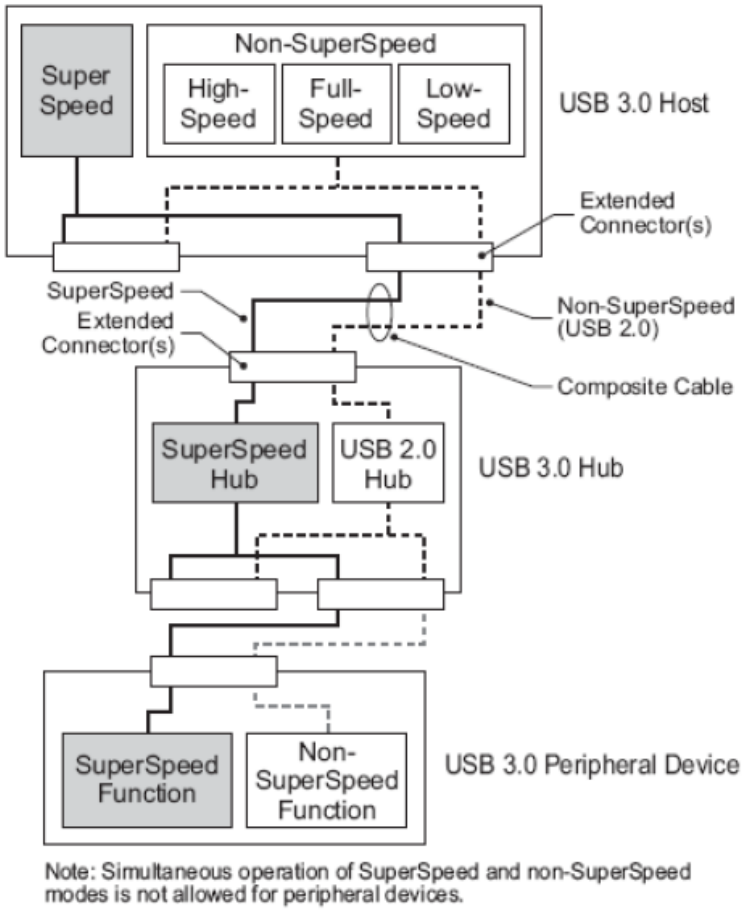
USB 3.0 Connectors

- Added pins for SuperSpeed USB signals
- Compatibility for USB 2.0 connectors
- USB 3.0 Standard B connector (middle) contains power and ground pins for device to supply power



USB 3.0 Bus Architecture

- Operates concurrently with USB 2.0 (Dual bus architecture)
  - Mechanically and electrically backward/forward compatible
  - Devices configured at fastest signaling rate
  - Hubs contain additional ports
- Speed and power efficiency
  - Non polling reduces power consumption
  - Additional data lines included to increase speed
  - Efficiency of bandwidth – simultaneous communication between host and device
    - Dedicated in and out lines allow communication between host and device

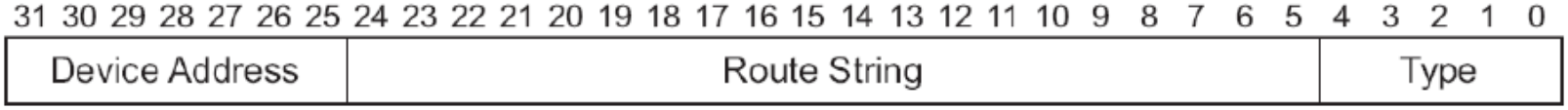


USB 3.0 Architecture Cont.

- Physical Layer
  - Adopted from current industry specs
  - Signaling similar to existing high-speed buses
    - PCI Express
    - SATA

USB 3.0 Packet Handling

- All data transfers initiated by host
- Hub can be up to 5 layers deep (127 devices)
- Packets routed NOT broadcast
- Hubs use “store and forward” procedures
  - Packets held by hub which are being directed to inactive port
- Downstream packets use route string to navigate to device
- Upstream always contains host as destination



USB 3.0 Power Management

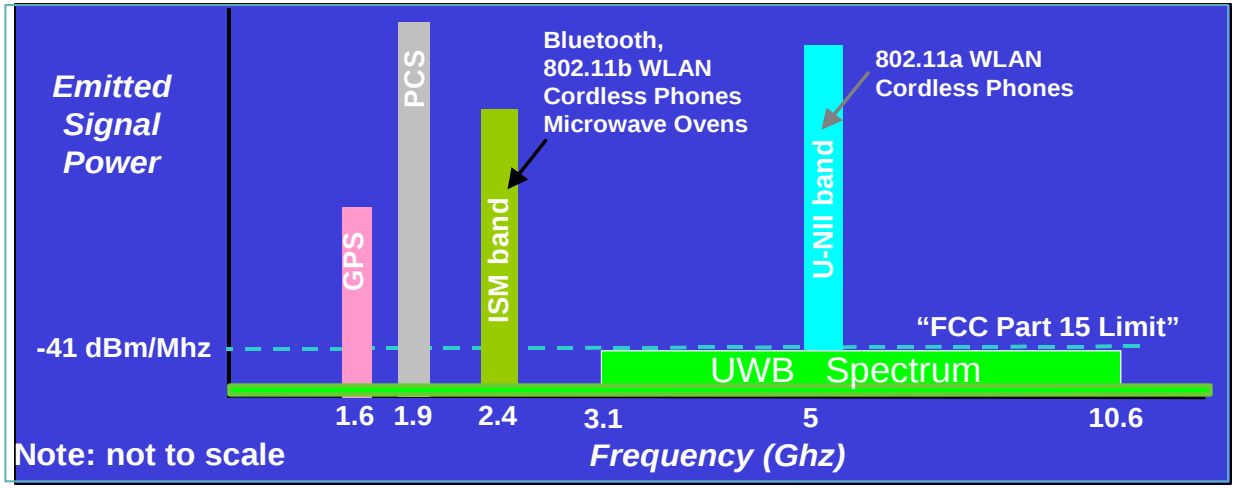
- Host to Device
  - Sends PPT (Packet Pending Transfer)
  - When no PPT, device can reduce power usage
- Use of packet suspension and asynchronous notifications
- Hub inactivity timers

Wireless USB

- WUSB is a form of USB technology that uses radio-frequency (RF).
- WUSB technology is based on the WiMedia Ultra-Wideband common radio platform.
- WUSB can provide transfer rates up to 480 Mbps (at 3 m) or 110 Mbps (at 10 m).
- WUSB also allows for no more then 127 devices connected to a single host controller.

What is Ultra-Wideband

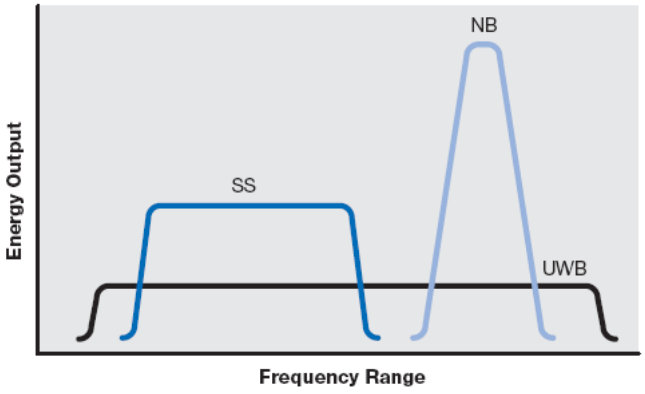
- “UWB is a radio technology that can be used at very low energy levels for short-range high-bandwidth communications by using a large portion of the radio spectrum” [1]
- Broader spectrum and lower power improves speed and reduces interference of other devices



What is UWB cont'd

- UWB differs substantially from other narrowband RF and SS, such as:
  - Bluetooth Technology
  - 802.11a/b/g.
- Also allows for more data transfer in a given period of time.

Figure 2. Comparison of narrowband (NB), spread spectrum (SS), and ultra-wideband (UWB) signal concepts



SS = Spread Spectrum
NB = Narrowband
UWB = Ultra-Wideband

Why Wireless USB

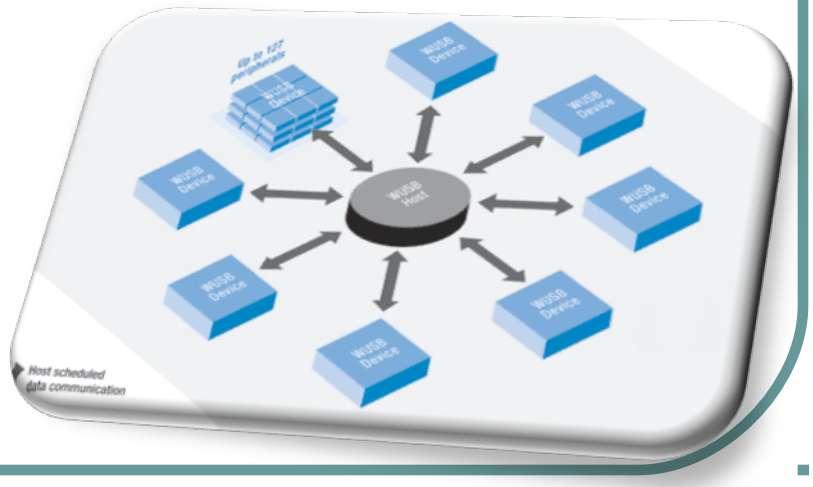
- The demand for increased connectivity without the clutter
- Preserves the USB 2.0 layered architecture and communication flow
  - Point-to-point
  - Same transfer types, etc
- WUSB interface still offers Plug and Play capability as well as hot swap hardward components
- Maintains Backward Compatibility (1.0 and 2.0)

Architectural Overview

- A USB system consists of a host and some number of devices all operating together on the same time base and logical interconnect.
- USB system can be described by three definitional areas:
  - USB interconnect
  - USB devices
  - USB host
- USB interconnect is the manner in which USB devices are connected to and communicate with the host.
- This includes the following:
  - Topology
  - Data Flow Models
  - USB Schedule

Topology

- WUSB uses a “hub and spoke” model
- WUSB host is the ‘hub’ and devices sit on the end of a ‘spoke’
- Each spoke provides a point-to-point connection

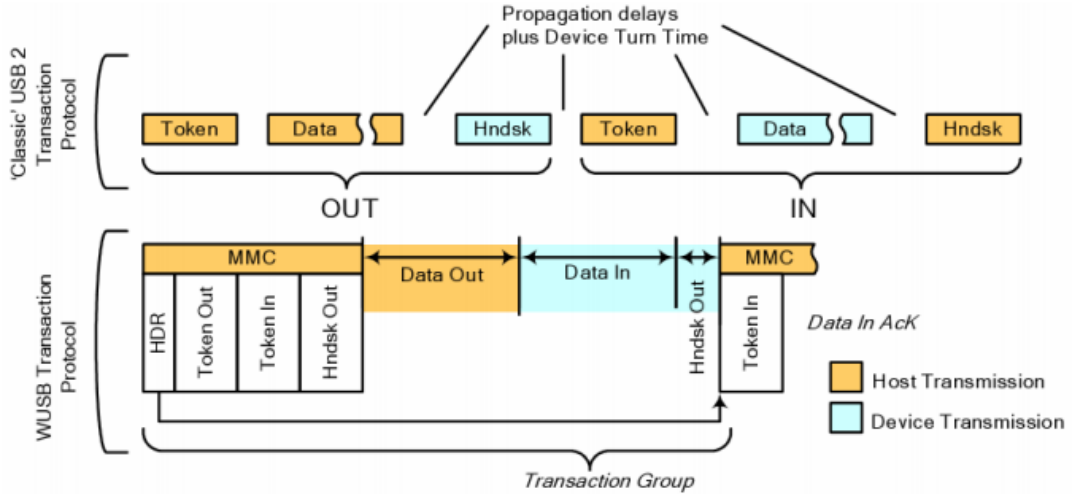


Bus Protocol

- WUSB is polled, TDMA based protocol (similar to wired USB)
- The Host Controller initiates all data transfers
- Consists of 3 packets:
  - Token
  - Data
  - Handshake

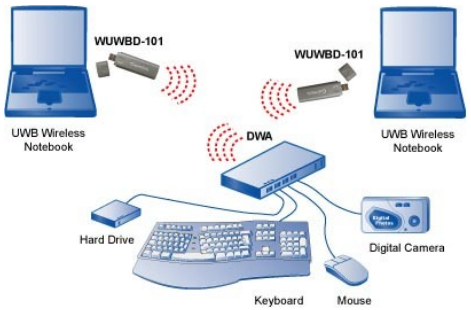
Bus Protocol cont'd

- To increase efficiency and eliminate costly sending and receiving transitions
- The hosts combine multiple token information into a single packet
- In this packet the host indicates the specific time when:
  - The devices should listen for data OUT or transmit an IN data packet or Handshake



Applications

- Wireless video display
- Home and office
- MP3s
- General data transfer
- And More



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Questions

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