GOVT.POLYTECHNIC COLLEGE

VECHOOCHIRA, PATHANAMTHITTA

SEMINAR REPORT
ON

WIRELESS USB

Submitted
By
SANGEETH.S

DEPARTMENT OF COMPUTER ENGINEERING

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GOVT.POLYTECHNIC COLLEGE

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CERTIFICATE

This is to certify that the report on "**WIRELESS USB**" is a record of seminar presented by.....

Reg no: ..... in towards the partial fulfillment for the award of the Diploma in Computer Engineering during the academic year 2009-2010 under the Directorate of Technical Education, Govt. of Kerala.

Seminar Coordinator Head of Section

External Examiner Internal Examiner

ACKNOWLEDGEMENT

It is a pleasure to recollect the faces that passes through the way of completing my effort successfully. I am not sure, if these words are enough to express my liability to pay my thanks.

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With pleasure

SANGEETH.S

CONTENTS

1. INTRODUCTION

The original motivation for USB came from several considerations, two of the most important being:

i. Ease of use

The lack of flexibility in reconfiguring PC had been acknowledged as the Achilles' heel to its further deployment. The combination of user friendly graphical interfaces and the hardware and software mechanisms associated with new-generation bus architectures have made computers less confrontational and easier to reconfigure. However from end users point of view, the PC's I/O interfaces, such as serial parallel ports, keyboard mouse interfaces etc. Did not have the attributes of plug and play.

ii. Port expansion

The addition of external peripherals continued to be constrained by port availability. The lack of a bidirectional, low cost, low-to mid speed peripheral bus held back the creative proliferation of peripherals such as storage devices, answering machines, scanners, PDA's, keyboards, mice etc. Existing interconnects were optimized for two point products. As each new function or capability was added to the PC, a new interface has been defined to address this need.

Initially USB provided two speeds (12Mbps and 1.5Mbps) that peripherals could use. But as PC's became increasingly powerful and able to process vast amounts of data, users need more and more data into and

out of the PCs. USB 2.0 was defined in 2000 to provide a third transfer rate of 480Mbps while retaining backward compatibility.

Now as technology innovation marches forward, wireless technologies are more capable and cost effective. Ultra Wide Band (UWB) radio technology, in particular, has characteristics that match traditional USB usage models very well. UWB supports high bandwidth (480 Mbps) but only at limited range (~3m). Applying this wireless technology to USB frees the user from worrying about the cables; where to find them, where to plug them in, how to string them so they don't get tripped over, how to arrange them so they don't look like a mess. It makes USB m ore easier to use. Because no physical ports are required, port expansion or even finding a USB port is no longer a problem.

Of course, losing the cable also means losing the power for peripherals. For self powered devices, this isn't an issue. But for portable, bus-powered devices, Wireless USB presents some challenges where creative minds will provide innovative solutions that meet their customer's needs.

USB (wired or wireless) continues to be the answer to connectivity for the PC architecture. It is a fast, bi-directional, isochronous, low-cost, dynamically attachable interface that is consistent with the requirements of the PC platform of today and tomorrow.

Wireless USB is used in game controllers, printers, scanners, digital cameras, MP3 players, hard disks and flash drives. It is also suitable for transferring parallel video streams.

1.1 WIRED USB

A USB system has an asymmetric design, consisting of a host, a multitude of downstream USB ports, and multiple peripheral devices connected in a tiered-star topology. Additional USB hubs may be included in the tiers, allowing branching into a tree structure, subject to a limit of 5 levels of tiers. A USB host may have multiple host controllers and each host controller may provide one or more USB ports. Up to 127 devices, including the hub devices may be connected to a single host controller.

The USB Specification provides a selection of attributes that can achieve multiple price/performance integration points and can enable functions that allow differentiation at the system and component level.

Features are categorized by the following benefits:

i. Easy to use for end user

- Single model for cabling and connectors
- Electrical details isolated from end user (e.g., bus terminations)
- Self-identifying peripherals, automatic mapping of function to driver and Configuration
- Dynamically attachable and reconfigurable peripherals

ii. Wide range of workloads and applications

- Suitable for device bandwidths ranging from a few kb/s to several hundred Mb/s

• Supports isochronous as well as asynchronous transfer types over the same set of wires

• Supports concurrent operation of many devices (multiple connections)

• Supports up to 127 physical devices

• Supports transfer of multiple data and message streams between the host and devices

• Allows compound devices (i.e., peripherals composed of many functions)

• Lower protocol overhead, resulting in high bus utilization

iii. Isochronous bandwidth

• Guaranteed bandwidth and low latencies appropriate for telephony, audio, video, etc.

iv. Flexibility

• Supports a wide range of packet sizes, which allows a range of device buffering options

• Allows a wide range of device data rates by accommodating packet buffer size and latencies

• Flow control for buffer handling is built into the protocol

v. Robustness

• Error handling/fault recovery mechanism is built into the protocol

• Dynamic insertion and removal of devices is identified in user-perceived real-time

• Supports identification of faulty devices

vi. Synergy with PC industry

• Protocol is simple to implement and integrate

- Consistent with the PC plug-and-play architecture
- Leverages existing operating system interfaces

vii. Low-cost implementation

- Low-cost sub channel at 1.5 Mb/s
- Optimized for integration in peripheral and host hardware
- Suitable for development of low-cost peripherals
- Low-cost cables and connectors
- Uses commodity technologies

viii. Upgrade path

- Architecture upgradeable to support multiple USB Host Controllers in a system

1.2 REASONS FOR WIRELESS USB

The wired USB is there to help with the PC connectivity problems. We already have many wireless solutions also, like Wi-Fi, Bluetooth etc. In such a scenario why are we going for a new technology called Wireless USB. Two things account for this, one is lack of easiness of use in wired USB the other one is inefficiency of current wireless solutions.

i. Issues of wired USB

- Wires are restrictive. Once plugged into a socket we cannot move the device around like what we can do with wireless or mobile devices. This restriction to free movement is a hindrance to the modern ideas of Mobile offices.
- Multiple wires can be a hassle. No one likes t o see the multitude of Wires behind the PC, some times making knots with each other and causing all sorts of trouble when we try to remove or reconfigure any component. To remove all these problems with no loss at all is a good idea and Wireless USB does that
- In many situations wireless solutions can easily deliver same speeds that wired solutions are delivering. So there is a good reason for a shift to wireless solutions.

ii. Inadequacy of current wireless solutions

- Bluetooth
  - Bandwidth of 3 Mbps is not enough for most of the applications which needs very high bandwidth. The applications like video; HDTV, monitor etc. are good examples.
- Wi-Fi
  - One of the main disadvantages of Wi-Fi is its high expense to set up a network and make it working. It is not always feasible to install Wi-Fi for home or personal networks.
  - Another draw back of Wi-Fi is the higher power consumption.
  - Power consumption is one of the important hurdles of wireless designers. As the wireless devices work on their own power, most always battery power, the high power consumption becomes a big drawback.

2. RADIO ENVIRONMENT

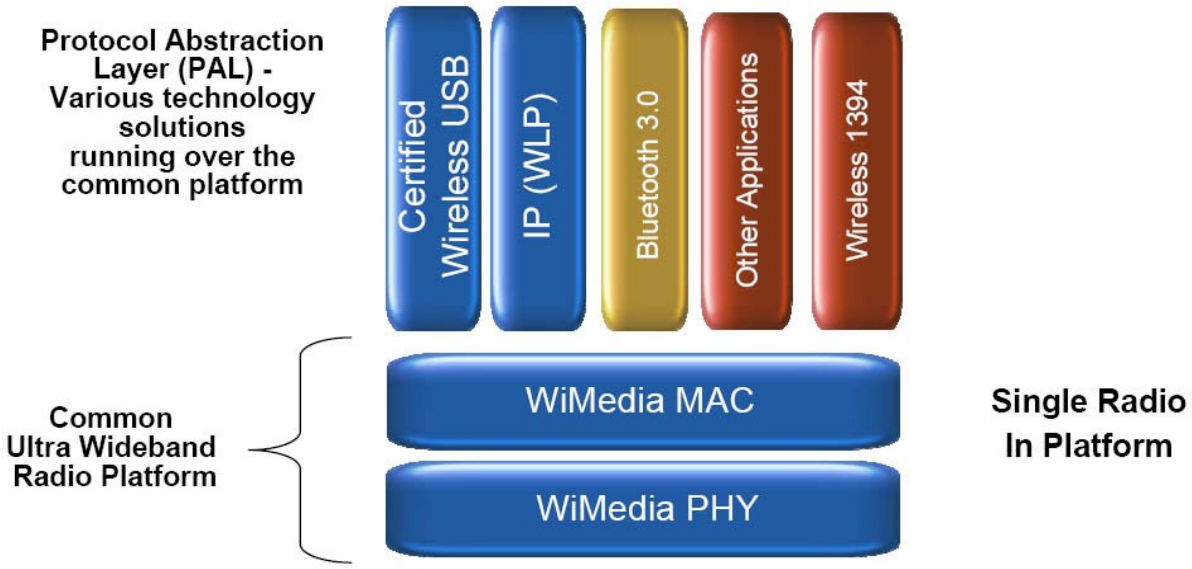
2.1 UWB

Ultra-wideband (UWB, ultra-wide band, ultra band, etc.) is a radio technology can be used at very low energy levels for short-range high bandwidth communications by using a large portion of the radio spectrum. This method is using pulse coded information with sharp carrier pulses at a bunch of center frequencies in logical conned. UWB has traditional applications in non cooperative radar imaging. Most recent applications target sensor data collection, precision locating and tracking applications.

UWB is a general term for a new type of radio communication using pulses of energy which spread emitted Radio Frequency energy over 500 MHz+ of spectrum or exceeding 20% fractional bandwidth within the frequency range of 3.1 GHz to 10.6 GHz as defined by the FCC ruling issued for UWB. UWB is NOT specific to WiMedia or any other company or group and there are in fact a number of groups and companies developing UWB technology totally unrelated to Wi-Media. Some companies use UWB for Ground Penetration RADAR, through wall RADAR and yet another company Pulse-LINK uses it as part of a whole home entertainment network using UWB for transmission over both wired and wireless media. WUSB is a protocol promulgated by the USB-IF that uses Wi-Media UWB radio platform. Other protocols that have announced their intention to use

WiMedia UWB radio platform include Bluetooth and the Wi-Media Logical Link Control Protocol.

The below figure explains the exact position of WiMedia UWB in the protocol stack of different wireless technologies including WUSB.

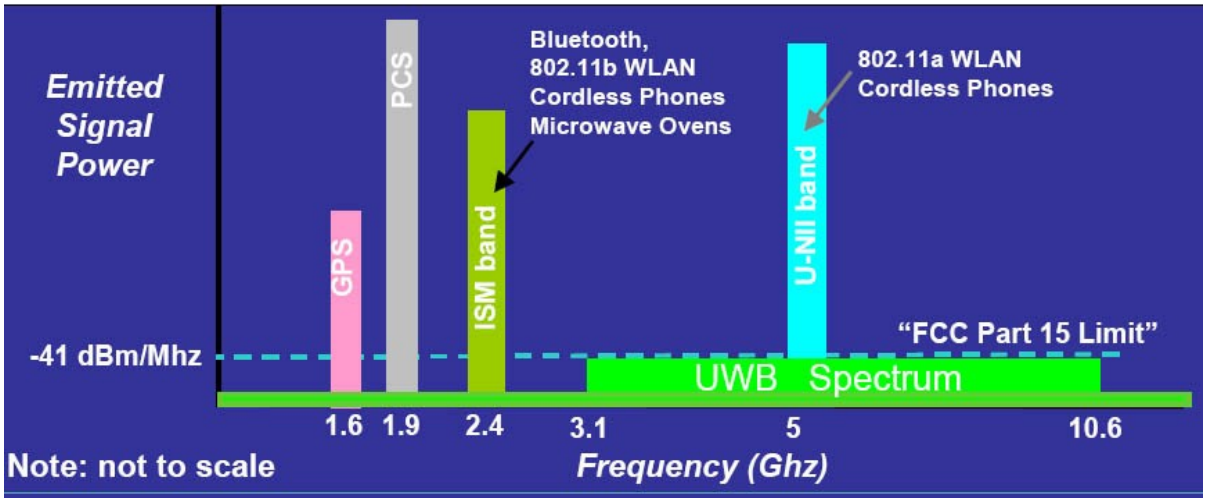


Position of UWB in protocol stacks

Ultra-Wideband (UWB) may be used to refer to any radio technology having bandwidth exceeding the lesser of 500 MHz or 20% of the arithmetic center frequency, according to Federal Communications Commission (FCC). A February 14, 2002 Report and Order by the FCC [1] authorizes the unlicensed use of UWB in 3.1– 10.6 GHz. The FCC power spectral density emission limit for UWB emitters operating in the UWB band is -41.3dBm/MHz. This is the same limit that applies to unintentional emitters in the UWB band, the so called Part 15 limit. However, the emission limit for UWB emitters can be significantly lower (as low as -75 dBm/MHz) in other segments of the spectrum.

Deliberations in the International Telecommunication Union Radio communication Sector (ITU-R) have resulted in a Report and Recommendation on UWB in November 2005. National jurisdictions around the globe are expected to act on national regulations for UWB very soon. The UK regulator Ofcom announced a similar decision [2] on 9 August 2007. Other national regulatory bodies apparently are somewhat reluctant to allow common unlicensed use

The below figure illustrates the position of UWB spectrum in the whole band used for common radio communications.



The UWB Spectrum

2.2 WI-MEDIA PHY

PHY is a common abbreviation for the physical layer of the OSI model.

A PHY connects a link layer device (often called a MAC) to a physical medium such as an optical fiber or copper cable. A PHY typically includes a PCS (Physical Coding Sub layer) and a PMD (Physical Medium Dependent) layer. The PCS encode and decodes the data that is transmitted and received. The purpose of the encoding is to make it easier for the receiver to recover the signal.

2.3 WIMEDIA MAC

The **Media Access Control** (MAC) data communication protocol sub-layer, also known as the Medium Access Control, is a sub layer of the Data Link Layer specified in the seven-layer OSI model (layer 2). It provides addressing and channel access control mechanisms that make it possible for several terminals or network nodes to communicate within a multipoint network, typically a local area network (LAN) or metropolitan area network (MAN).

The MAC sub-layer acts as an interface between the Logical Link Control (LLC) sub layer and the network's physical layer. The MAC layer emulates a full duplex logical communication channel in a multipoint network. This channel may provide unicast, multicast or broadcast communication service.

The channel access control mechanisms provided by the MAC layer are also known as a multiple access protocol. This makes it possible for several stations connected to the same physical medium to share it. Examples of shared physical media are bus networks, ring networks, hub networks, wireless networks and half duplex point-to-point links. The multiple access protocol may detect or avoid data packet collisions if a packet mode contention based channel access method is used, or reserve resources to establish a logical channel if a circuit switched or channelization based channel access method is used. The channel access control mechanism relies on a physical layer multiplex scheme.

The most widespread multiple access protocol is the contention based CSMA/CD protocol used in Ethernet networks. This mechanism is only utilized within a network collision domain, for example an Ethernet bus network or a hub network. An Ethernet network may be divided into several collision domains, interconnected by bridges and switches

A multiple access protocol is not required in a switched full-duplex network, such as today's switched Ethernet networks, but is often available in the equipment for compatibility reasons.

3. HIGH LEVEL ARCHITECTURE

3.1 TECHNOLOGY FEATURES

Wireless USB will build on the success of Wired USB. An important goal of the WUSB Promoter Group is to ensure that wireless USB offers users the experience they have come to expect from wired USB. Toward that end, the Wireless USB standard is being designed to support the following features.

i. Backward compatibility

Wireless USB will be fully backward compatible with the one billion wired USB connections already in operation. Moreover, Wireless USB will be compatible with current USB drivers and firmware and provide bridging from wired USB devices and hosts.

ii. High performance

At launch, Wireless USB will provide speeds up to 480 Mbps, a performance comparable to the wired USB 2.0 standard and high enough to provide wireless transfer of rich digital multimedia formats. As UWB technology and process technologies evolve, bandwidth may exceed 1 Gbps.

iii. Simple, low-cost implementation

Implementation will follow the wired USB connectivity models as closely as possible to reduce development time and preserve the low-cost, ease-of-use model that has made wired USB the interconnect of choice.

iv. An easy migration path

To enable an easy migration path from wired USB, Wireless USB will maintain the same usage models and architecture as wired USB

3.2 WIRELESS USB TOPOLOGY

The fundamental relationship in WUSB is a hub and spoke topology, as shown in Figure, In this topology, the host initiates all the data traffic among the devices connected to it, allotting time slots and data bandwidth to each device connected. These relationships are referred to as clusters. The connections are point-to-point and directed between the WUSB host and WUSB device.

The WUSB host can logically connect to a maximum of 127 WUSB devices, considered an informal WUSB cluster. WUSB clusters coexist within an overlapping spatial environment with minimum interference, thus

allowing a number of other WUSB clusters to be present within the same radio cell.

Topology will support a dual role model where a device can also support limited host capabilities. This model allows mobile devices to access services with a central host supporting the services (i.e., printers and viewers). This model also allows a device to access data outside an existing cluster it may currently be connected to by creating a second cluster as a limited host.

Additionally, high spatial capacity in small areas is needed to enable multiple device access to high bandwidth concurrently. Multiple channel activities may take place within a given area. The topology will support multiple clusters in the same area. The number of clusters to be supported is still being determined.

3.3 POWER MANAGEMENT

Radio system power (power used only by the radio) will be expected to meet the most stringent requirements where mobile and handheld battery life is important. For example, typical PDAs use 250–400 mW without a radio connection, while typical cellular phones use 200 mW–300 mW with the primary WAN radio. Adding a WUSB radio should not increase power requirements any more than existing wireless technologies already employed today.

Battery-powered operation requires reasonable battery life: 2–5 days for highly mobile devices and several months for intermittently used devices like remote controls. WUSB, based on the MultiBand OFDM Alliance (MBOA) radio, will strive to meet these standards. The power target for WUSB radio will be introduced at less than 300 mW and drive to a target of 100 mW over time.

3.4 PERFORMANCE

WUSB performance at launch will provide adequate bandwidth to meet the requirements of a typical user experience with wired connections. The 480 Mbps initial target bandwidth of WUSB is comparable to the current wired USB 2.0 standard. With 480 Mbps being the initial target, WUSB specifications will allow for generation steps of data throughput as the ultra wideband radio evolves and with future process technologies, exceeding limits of 1 Gbps.

The specification is intended for WUSB to operate as a wire replacement with targeted usage models for cluster connectivity to the host and device-to-device connectivity at less than 10 meters. The interface will support quality delivery of rich digital multimedia formats, including audio and video, and will be capable of high rate streaming (isochronous transfers).

3.5 SECURITY AND ASSOCIATION

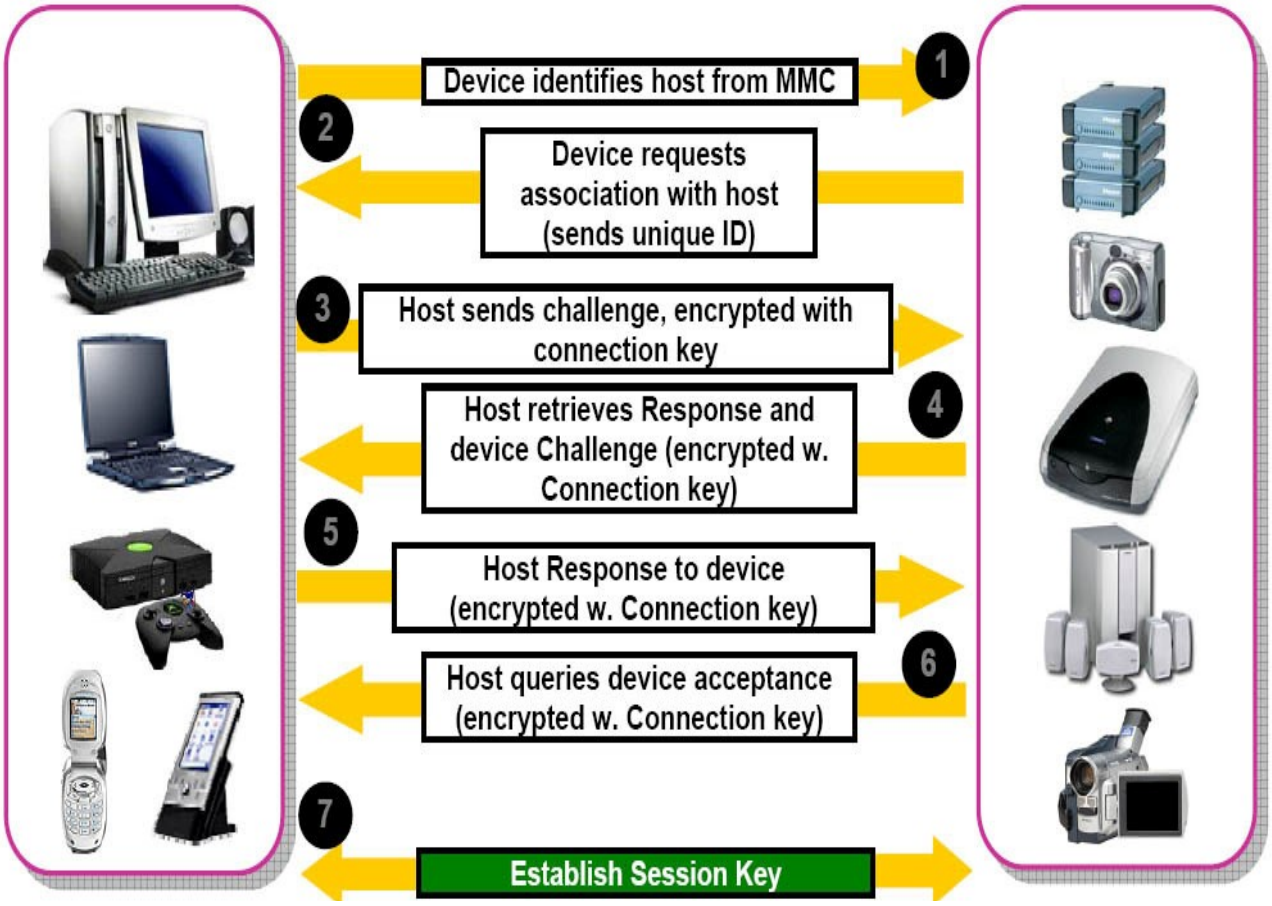
WUSB security will ensure the same level of security as wired USB. Connection level security between devices will ensure that the appropriate device is associated and authenticated before operation of the device is permitted. Higher levels of security involving encryption should be implemented at the application level. Processing overhead supporting security should not impose noticeable performance impacts or add device costs.

One of the primary objectives when implementing a wireless interconnects is that it is easy to install and use. Wired connections provide the user with implied expectations, that is that the device is connected as specified by the user when they install the wire. When the wire is installed, the user has basic expectations and when these expectations do not take place (plug does not fit), there is a known recourse.

Wireless connections, on the other hand, due to environmental characteristics, may establish connection paths that are not obvious. In fact, it may not be obvious when a device is connected.

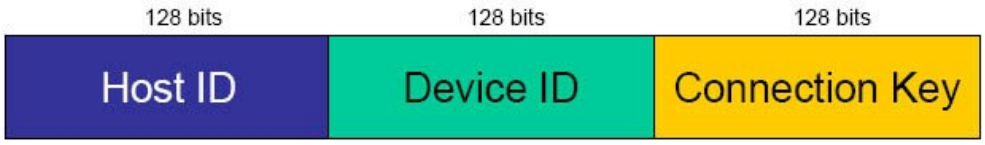
So WUSB devices installed for the first time should automatically install drivers, security features, and so on and associate with systems that they can interact with. The concepts of 'turn on and use it' with an easy setup procedure will be employed.

3.5.1 SAMPLE DEVICE CONNECT



3.5.2 CONNECTION CONTEXT

In order to make secure relationships consistent across multiple connections, some amount of context must be maintained by both device and host. In the case of wireless USB. This connection context consists of three pieces of information., a unique host ID (CHID), a unique device ID (CDID) and a symmetric key (CK) that is shared by both parties. The symmetric key is referred to in this document as the connection key. This key is used to reestablish the connection at a later time. This key is always unique. The host never gives the same connection key to multiple devices.



A connection context must contain non zero CHID and CDID values to be useable by the device. A host can use a CC with a value of zero in either field to revoke an existing context. When loading a context for connection purposes, if a device discovers a CC that contain CHID or CCID values of zero , it shall treat that CC as if it were entirely blank. The device shall make no use of the other fields.

Devices may find ways to add value by supporting multiple CCs. Each CC supported by the device must contain a unique CHID. In the case a device supports multiple CCs only the CC used to connect the host shall be made accessible to the host.

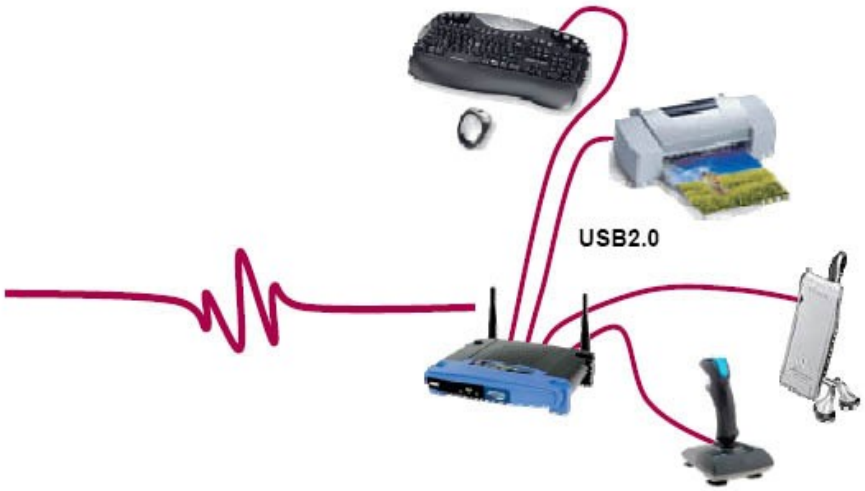
3.6 ENABLING PRODUCTS

It is useful to note in a discussion regarding Wireless USB is that the end goal of the solution is to provide a cable replacement for a pure USB connection. Many Wireless USB adapters exist today, but these adapters do not perform the function required of a true Wireless USB solution.

A USB adapter, devices such as USB-to-Serial, USB-to-Ethernet, USB-to-802.11 and USB modems (USB-to-Telco or USB-to-Cable TV), provides an external connection and protocol conversion that just happens to connect to the PC via USB. The USB device itself is the dongle or adapter unit directly connected to the host. The remote side is not a USB device, and the connection is not USB. The goal of a true Wirelesses solution is to enable connectivity of any USB device, and provide the same convenience of a simple wired USB connection.

3.6.1 DEVICE WIRE ADAPTERS

Device wire adapter looks like a simple USB hub. It consists of traditional USB A type ports in it and USB devices can connect to it with the wired USB technology. The DWA connects wirelessly to the HWA or the wireless host integrated into the host machine as PCI or PCI (e). Single chip implementations of DWA can be directly integrated into devices which makes no need for the hub. A sample figure of a device wire adapter is shown below



Device Wire Adapter: DWA

3.6.2 HOST WIRE ADAPTERS

Host wire adapters lies on the WUSB host they are small adapters that look like a dongle which can be connected to the USB ports of the host computer. This host wire adapters make use of the wired USB connection to connect to the host PC and the wireless USB technology to connect to the Device wire adapters to which the wireless USB devices are connected.

The whole connection makes a mixture of wired and wireless connection which leads to decrease in throughput. It is always recommended to use the wireless host integrated into the host system.

4. CONCLUSION

The first Wireless USB implementations will likely be in the form of discrete silicon that will be introduced in a number of form factors. These may include add-in cards and dongles along with embedded solutions to support the technology's introduction and subsequent rapid ramp up.

But the wireless future will arrive once WUSB, along with the common ultra wideband platform, becomes a standard part of every processor and chipset and is integrated in CMOS silicon.

As the latest iteration of USB technology, wireless USB (WUSB) will offer the same functionality as standard wired USB devices but without the cabling. As the new Wireless USB Promoter Group prepares to develop the specifications that will help standardize the technology, the industry is planning products that can take advantage of the convenience and mobility that this new device interconnect will offer.

5. REFERENCE

1) www.usb.org
2) www.intel.com/technology/usb
3) www.wikipedia.com