Wireless Universal Serial Bus

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Outline

- Wired Universal Serial Bus (USB)
- Overview of Wireless USB (wUSB)
  - History/Vision
  - Features
- How wUSB Works
  - Design
  - Security
- Issues/Limitations
- Current Implementations
- Future/Conclusion

Wired USB

- Overview
  - Plug/Play standard for peripheral devices
  - Standardized by the USB Implementers Forum
- Technical Details
  - Host/Slave Connection
    - PC (host) manages all transfers; peripherals (slave) just responds
    - Supports 127 slaves per host
  - Physical Connection
    - Four wire connection
      - Two wires for power (+5 and GND)
      - Two wires (twisted pair) for synchronous serial data
    - Computer supplies power (up to 500 mA)

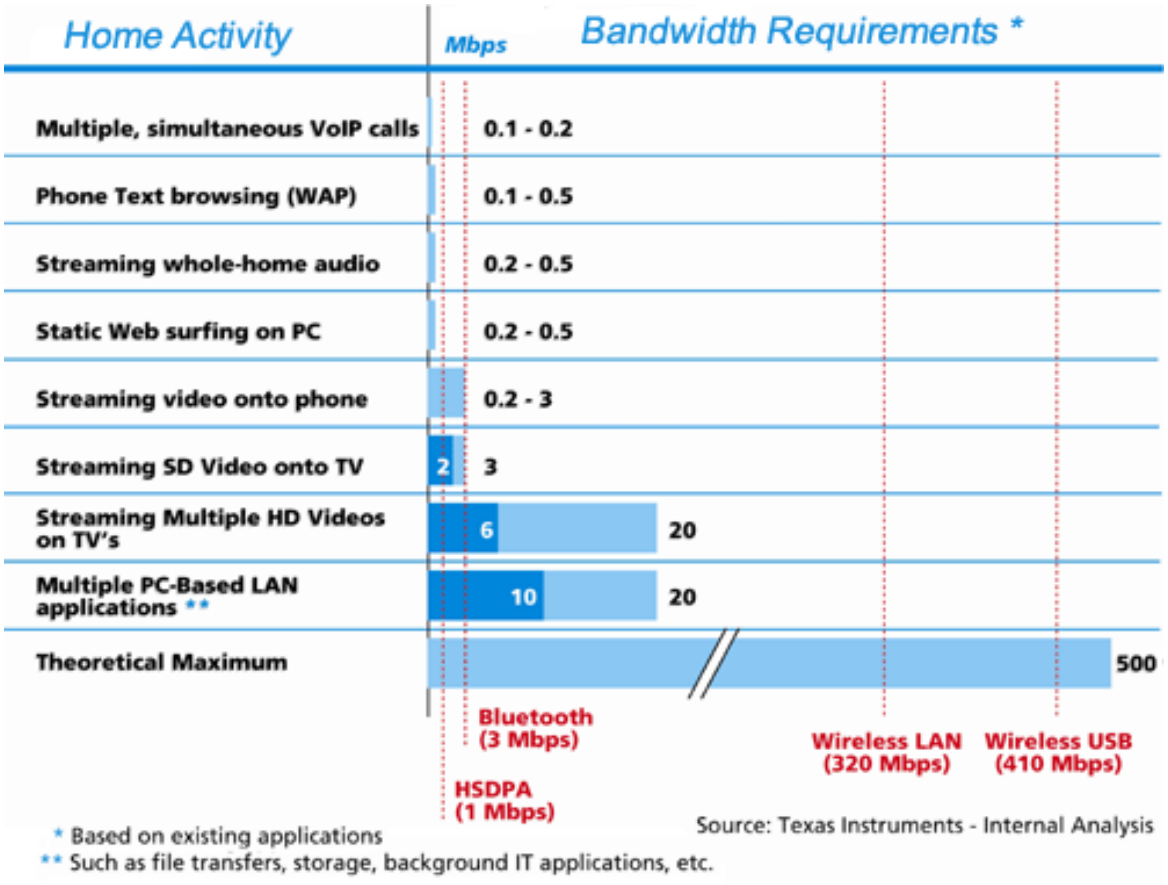
Wired USB

- Technical Details (Cont.)
  - Data Rates
    - Low Speed: 1.5 Mbps (Keyboards, mice, etc.)
    - Full Speed: 12 Mbps (USB1.1 max speed)
    - Hi-Speed: 480 Mbps (USB2.0 max speed)

Reasons For Wireless USB

- Wired Issues
  - Wires are restrictive
  - Multiple wires can be a hassle
  - Wires slower than wireless solutions
- Current wireless solutions inadequate
  - Bluetooth
    - Bandwidth of 3 Mbps not enough for higher demand applications (Video, HDTV, Monitor)
  - WiFi
    - Expensive
    - Too much power usage for mobile devices

Data Rate Comparisons



Wireless USB Overview

- Overview
  - Has evolved as companies figured out standards
  - Based on Ultra-Wideband (UWB) RF technology
  - UWB is a technology for transmitting data over a large bandwidth (>500 MHz)
- History of Ultra-Wideband (UWB)
  - Late 1800s: Started with Spark Gap radio for transmitting Morse Code
  - 1924: Spark Gap forbidden due to disruptive nature to narrowband carrier radios
  - 1960s – 1999s: Better test equipment promoted research of UWB for radar and communications

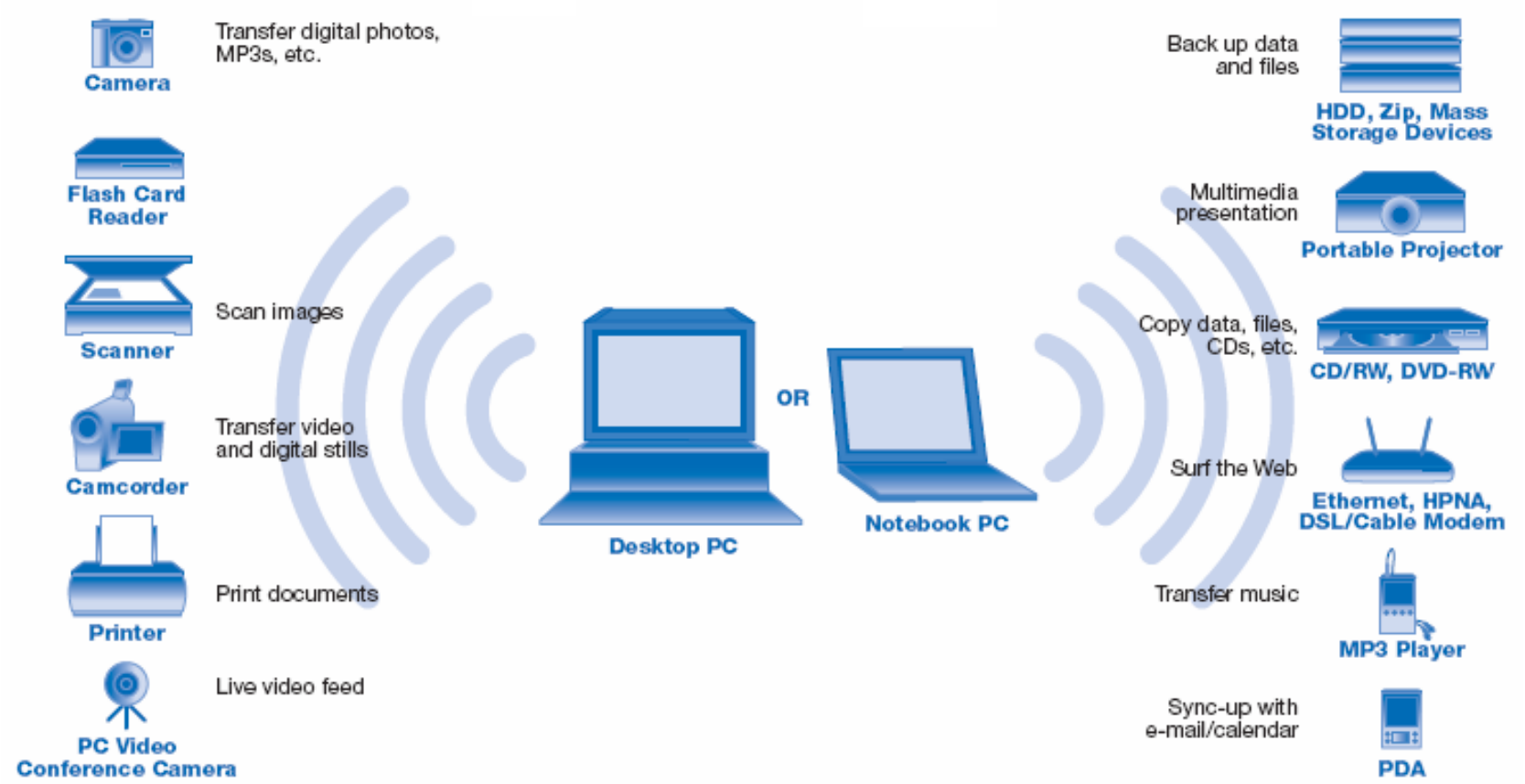
Wireless USB Overview

- History of Ultra-Wideband (cont.)
  - April 2002: FCC issued UWB Regulations
    - Permitted marketing and operation of new products
    - Limited power and freq range
  - 2002: Two standards emerge
    - Orthogonal Frequency Division Multiplexing (OFDM) UWB
      - WiMedia Alliance & Intel
    - Direct Sequence (DS) UWB
      - UWB Forum & Freescale
  - 2006: DS-UWB loses support & OFDM-UWB wins
    - Freescale left UWB Forum; became quiet
    - Many companies dropped Freescale chips
    - Freescale trying proprietary “Cable-Free USB”
  - 2007: Products begin to hit the market

Wireless USB Overview

- Goals of Intel OFDM-UWB Wireless USB Standard
  - Wireless version of USB; same features, speeds
  - Interoperable across three major platforms
    - Consumer Electronic devices (digital video/audio)
    - Mobile devices (cellular phones, PDA)
    - Personal Computing (laptop, PC, printer, peripherals)
  - High bandwidth to support demanding data transfer (High Definition, Monitors)
  - Mobile friendly
    - Low power usage
    - Inexpensive costs
    - Small physical implementation
  - High level of security
  - Next gen Wireless Personal Area Network (WPAN)

Wireless USB Vision

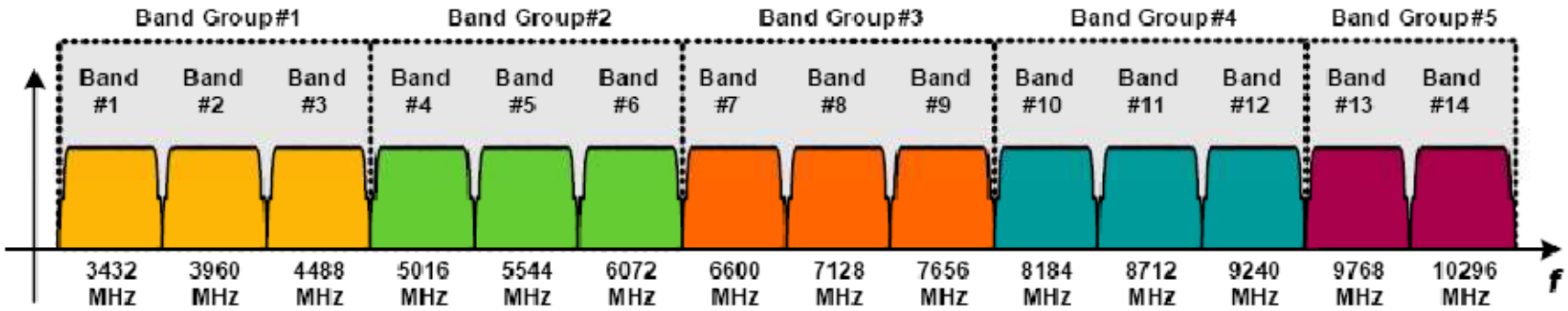


Wireless USB Physical Design

- Features of UWB
  - Speed/Range
    - Scaleable speeds up over 1 Gbps
    - Currently 480 Mbps at 3 m; 110 Mbps at 10 m
  - Frequency: 3.1 GHz to 10.6 GHz
    - Divided into 14 bands; 5 groups
      - Each band is 528 MHz wide
      - OFDM symbols are interleaved across all bands
      - Provides protection against multi-path / interference

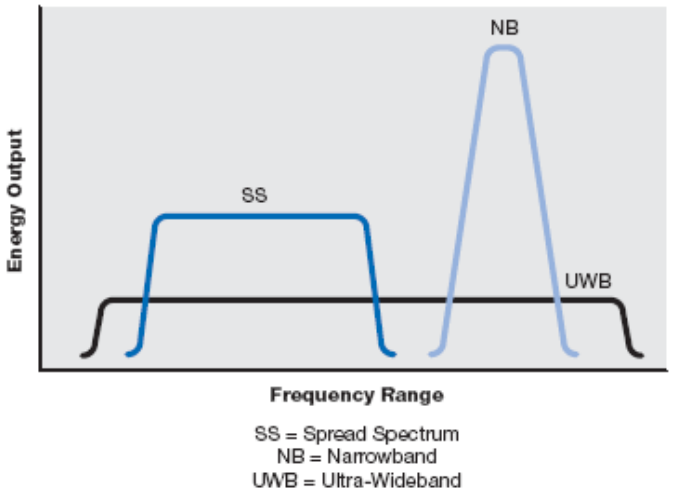
Wireless USB Physical Design

- Features of UWB (cont.)
  - Frequency: 3.1 GHz to 10.6 GHz (cont.)
    - Band Groups 1 & 2: Longer range apps
    - Bands Groups 3 & 4: Shorter range apps
    - Bands can be turned off to accommodate for conflicts or for regulations



Wireless USB Physical Design

- Features of UWB (cont.)
  - Power
    - Power is limited due to usage of wide spectrum
    - Low power for mobile devices and minimum interference
    - Max output to -41.3 dBm/MHz



Wireless USB Security Design

- Overview
  - Strongly stressed in wUSB specification and outlined in its own requirements document
  - Security needed due to crowded environments
  - Two major components: Association and Encryption
- Association
  - Overview
    - Device must first associate with the host in a one-time event
    - Accomplished via wired verification or numeric association

Wireless USB Security Design

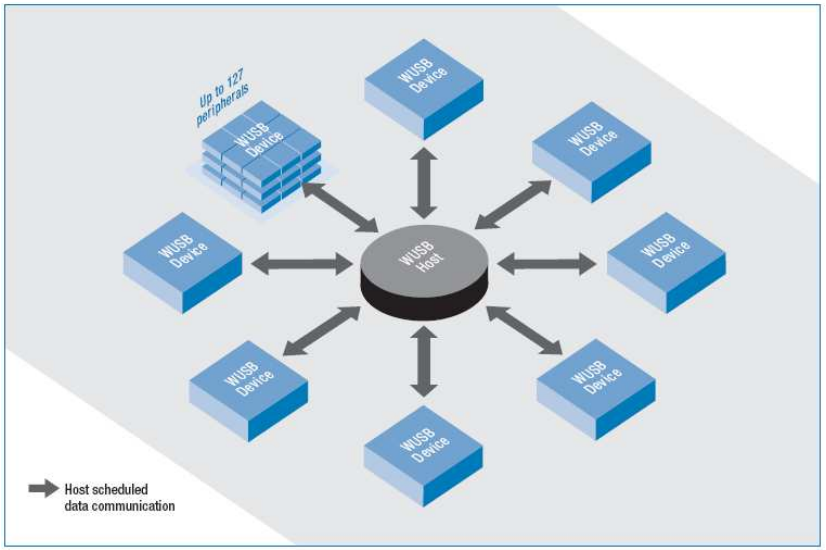
- Association (cont.)
  - Wired Verification
    - Cable is attached between devices
    - Exchanges a unique 384-bit identifier known as the “connection context”
  - Numeric Association
    - Devices associate wirelessly
    - User must enter a hex code manually

Wireless USB Security Design

- Encryption
  - Data encrypted with the AES 128 algorithm
  - During each session devices derive a session key based on “connection context”
  - Wireless data is encrypted using session key
  - Does not encrypt PHY and MAC headers

Wireless USB Connection Design

- Host/Slave Connection
  - Similar to wired USB (127 devices; host is PC)
  - Each host forms a cluster
  - Clusters can coexist with minimum interference
- Power Management
  - Sleep/Listen/Wake used to conserve power
  - Tx/Rx power management



Wireless USB Issues/Problems

- Interference Issues
  - Potential conflict to devices on same frequencies
  - "Detect and Avoid"
    - Wisair's solution to detect other frequencies
    - Switches to frequencies not being used
  - Conflict issues are more of a concern for wireless USB devices being overpowered
- Competing Standards
  - Cable-Free USB (Freescale)
  - USB-Implementers Forum (Intel, HP, Microsoft)

Wireless USB Implementations

- Belkin Cable Free Hub
  - Released Dec, 2006
  - Dongle attaches to PC
  - Retail price of $199.00
  - Speeds up to 480 Mbps

Wireless USB Implementations

- GeFen HMDI Extender
  - Coming soon…
  - Based on WiMedia Alliance specification
  - Retail price of $699.00
  - Range of 20 meters; data rates up to 480 Mbps
  - Frequency band: 3.1 - 4.8 GHz
  - Resolution support : 480i, 480p, 720p, and 1080i

Wireless USB Implementations

- Seagate Wireless USB Hard Drive
  - Coming soon…
  - 2.5 inches wide
  - Speeds up to 480 Mbps

Future of Wireless USB

- Early 2007
  - Initial devices being produced
- Late 2007
  - Expect wUSB being built into laptops, PCs, multimedia devices
- 2008
  - Visiongain research firm predicts increase of wUSB by 400 percent
- 2009-2010
  - Wide scale interoperability?

Concluding Thoughts

- Appears well designed; good support
- Slow start of products
  - Will it really catch on?
  - More products need to be developed
- Promises a lot; will it deliver?
- Security is very important

THANK YOU