Audio/Video Over USB

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July 2010

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Introduction

- USB has become a popular interface for exchanging data between PCs and peripherals
- An increasing number of portable peripherals are using the USB interface to communicate with PCs and other Embedded Hosts
- USB interface speeds make possible the transfer of multimedia-rich content (video/audio/metadata)
- Proprietary offerings have successfully demonstrated multimedia capabilities over USB, but a Standard would encourage wide industry adoption
- The USB-IF Device Working Group (DWG) stepped up to deliver a standard Audio/Video Class specification for sending Audio/Video content over USB

Why Audio/Video over USB?

- USB can transport video, graphics (OpenGL, for example) and its related audio and metadata information (for example, closed caption) over a single connection
- USB can transport content-protected information
  - Most movies are protected
  - Authentication & Encryption/Decryption through existing Content Security Class
- USB can transfer Audio/Video data in compressed or uncompressed formats
  - Different use cases call for different approaches
    - Productivity applications vs. movie playback
  - Allows optimization of the available bandwidth to enable coexistence with other applications
- USB has the bandwidth to carry high definition video
  - USB 3.0 enables uncompressed full HD video
  - Bandwidth continues to increase with USB 3.0 and future generations

Why Audio/Video over USB? (Cont'd)

- USB can use simple USB Hubs to connect to several displays at the same time and stream different content to each display
- USB can transfer control information bi-directionally between the source and the sink
  - For example, it is possible to control the projector in the ceiling from a Smartphone
- USB supports simultaneous content streaming bi-directionally
- There is no conceptual limit to the number of channels that can be sent over one physical connection
  - Limit only imposed by the available bandwidth
  - USB 3.0 already provides tenfold increase in BW over USB 2.0
    - Up to ~500 channels of DVD quality video (6Mbps over a 3Gbps pipe)
    - Up to ~100 channels of HD quality video (30Mbps over a 3Gbps pipe)

Why Audio/Video over USB? (Cont'd)

- Single cable and connector replaces all the audio and video connectors and cables
- USB connectors and cables are inexpensive
- The same USB connectors and cables are used for battery charging
- The same USB connectors and cables can be used for debug and firmware upgrades
- Most consumers already have USB cables

Why Audio/Video over USB? (Cont'd)

- USB is already present in all PCs
- USB is present in virtually all mobile platforms
- USB is present in most CE platforms
- ➢ Adding Audio/Video over USB requires no additional transport-related hardware cost

- Cost is mainly in software/firmware for implementing the Audio/Video class
- Extensible in the future without incurring additional cost
  - No change necessary to the underlying hardware
- No transport-related fees
  - Licensing

Example Audio/Video Devices and Use Cases

- PC uses USB Audio/Video to attach to second monitor
  - Monitor can have built-in speakers, microphone, and camera
- Cell phone connects to large monitor using USB Audio/Video
  - Enables productivity applications on the mobile platform
  - Cell phone charges while working
- Portable media/game player (or cell phone) connects to living room TV using USB Audio/Video
  - Charges while playing content
- Laptop uses a single USB connection to connect to docking station
  - External screen, keyboard, mouse, speakers, speakerphone
  - Network connectivity
  - Printer, scanner, backup hard disk
- PC uses USB Audio/Video to connect to cell phone's built-in camera as a webcam
- Many more…

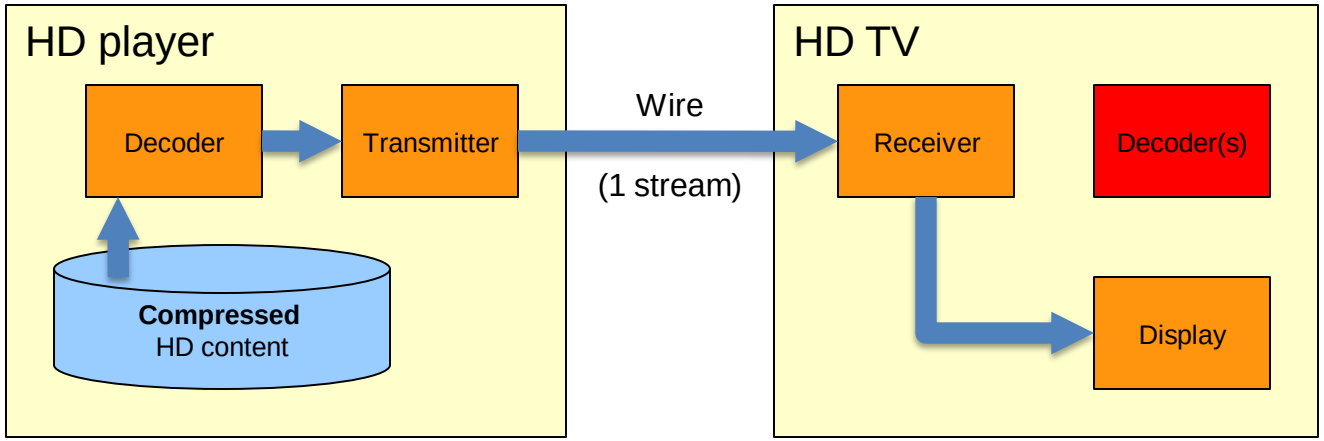
Compressed Video Considerations

- The quality of consumer video is a perception issue.
  - In people's minds, Highest Quality = Uncompressed
  - BluRay format today is considered the very best quality consumer material, yet it uses a *compressed* format on disc (MPEG2/MPEG4)
- Storage and bandwidth for media content distribution are very cost sensitive
- ➢ 2D and 3D HD consumer content are distributed in a compressed format
  - Most Audio/Video content available to consumers today
    - Via optical media
    - Via High-speed Internet

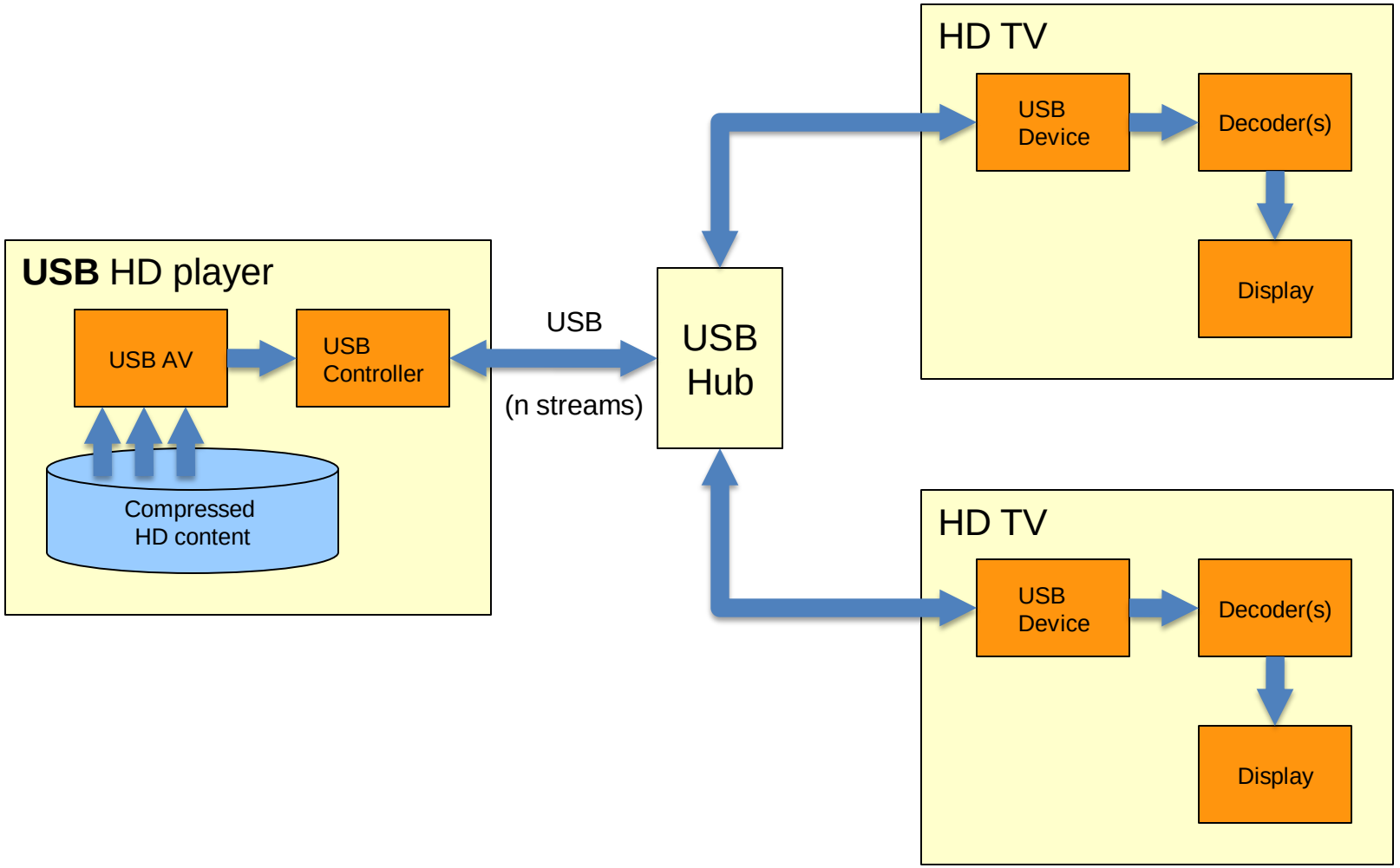
Compressed Video Considerations (Cont'd)

- Sending raw pixel data over a wire:
  - requires more bandwidth to send the same quality video as for compressed formats, leading to higher power consumption
  - Because of the higher bandwidth electrical requirements of the cable/connector are higher
  - Most (if not all) material sent uncompressed originates from compressed media
    - Decompression never increases video quality, takes place at source side
- USB Audio/Video:
  - supports both compressed and uncompressed streaming
  - In case of compressed, decompression takes place at sink side
    - The decoder moves to the piece of equipment that is likely to be more expensive.
    - The player cost can be reduced
  - Capable of sending and receiving multiple streams simultaneously between multiple devices
  - Does not require extra hardware for data transfer

Compressed Video Considerations (Cont'd)



Compressed Video Considerations (Cont'd)



Conclusions

- USB provides an excellent, inexpensive medium over which to deploy Audio/Video functionality
- USB Audio/Video delivers unprecedented control over the inner workings of the Audio/Video device
- USB Audio/Video supports (secure) bi-directional streaming to multiple devices simultaneously
- USB Audio/Video is designed for flexibility, scalability, and future extensibility

Call to Action

- Join the USB DWG Audio/Video Working Group to get access to the latest specification developments and to actively contribute to the future of the Audio/Video Device Class
  - https://www.usb.org/apps/org/workgroup/av/index.php
    - Signed USB-IF IP Agreement required to join and access link