

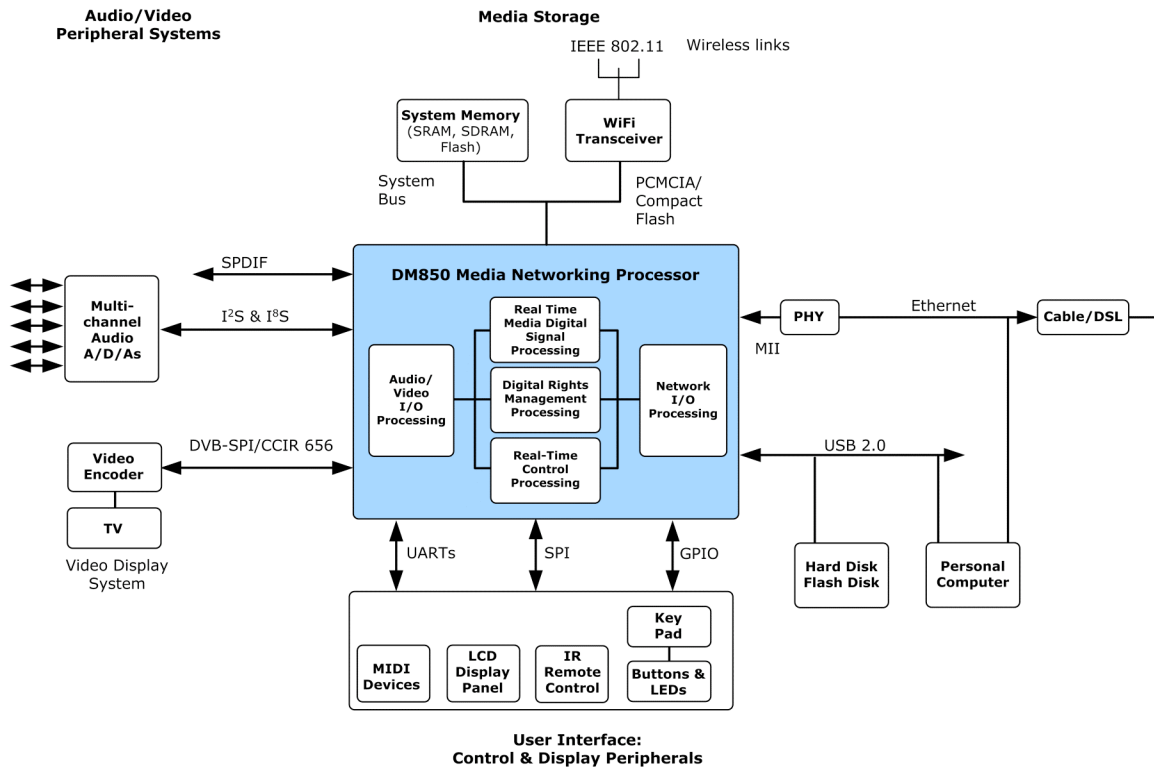
## **Abstract**

*Adding a USB interface to a digital audio player enables several new consumer applications. Care must be taken in implementing USB functionality to insure that the full benefits of the interface are realized by users.*

Network-capable consumer audio electronics, often called networked audio adapters or digital audio players, are a rapidly emerging audio product category. BridgeCo, a company that develops processor ICs and software for networked audio applications, has developed several criteria for implementing USB on networked audio products based on extensive user experience.

Digital media players [DMP] enable consumers to enjoy Internet radio stations and free or premium online music services in any room of their home, whether or not a computer is present on the home network. And DMPs also allow user to enjoy playback of computer-archived audio files in any room, and on any audio system, that is networked-connected. DMPs have been implemented as completely independent stand-alone systems with built-in speakers and controls, as stand-alone after-market adapters that add network connectivity to installed legacy audio equipment, and as network interface modules embedded into new audio systems.

In each case, the DMP product or embedded module must provide the necessary processing capability and software stack to handle networking protocols [e.g., TCP/IP], content decompression processing [e.g., MP3, WMA], DRM decryption and authentication processing [e.g., PlaysForSure Windows Media] and user interface functions. DMPs also must incorporate wired Ethernet, HomePlug<sup>TM</sup> and/or wireless 802.11b/g interfaces to implement a complete audio playback node on a home network.



Now that multiple DMP products have been successfully introduced into the market, manufacturers are seeking new features to differentiate their offerings and add value for consumers. USB interfaces, which have become ubiquitous on computers, peripherals and many other devices, can add flexibility and utility to DMPs by enabling a number of new applications and uses. In addition to sourcing audio content from the Internet or computer archives over a home network, USB-enabled DMPs can also directly access and playback audio files stored on flash drives, memory sticks, portable hard drives and mobile audio players. With USB-enabled DMPs, service providers can permit consumers to purchase songs locally that have just aired over premium online music services, storing the purchased content directly onto mobile phones and other portable devices right from the DMP. Potential USB applications and hardware will only accelerate. Market research

firm Instat<sup>1</sup> expects that the number of USB-enabled devices shipped annually will double from 1.4 billion in 2005 to 2.8 billion in 2010.

## **USB selection and implementation**

There are three main considerations when selecting the type of USB interface to implement on a DMP. USB interfaces have traditionally identified the implementing device as either a “host” or “peripheral.” Typically the computer was the host, and any attaching device was the peripheral. This topology is sufficient for a DMP when it is attaching to a computer for initialization, maintenance or data transfer functions. Once the DMP is remotely operated as a network node audio player, however, it will need to assume the host function when interfacing to a storage device, mobile player or phone. To achieve maximum utility, DMPs should therefore implement USB OTG (on-the-go), which enables the DMP to flexibly act as either a host or peripheral.

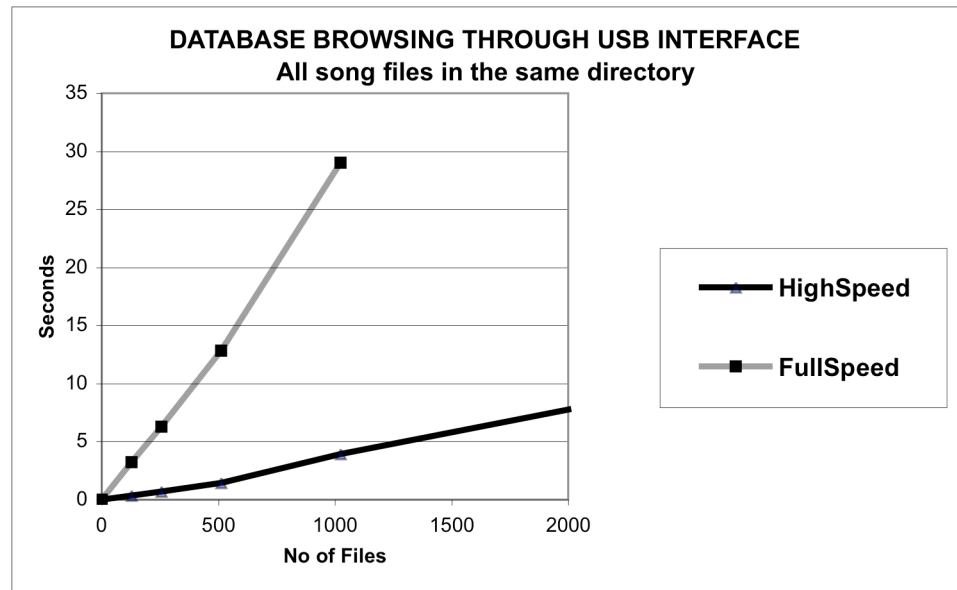
A second critical USB consideration is data transfer rate. With the introduction of USB 2.0, data transfers of 480mbps are possible, a dramatic increase over the 12mbps of USB 1.1. But not all USB 2.0 devices are created equal. The USB standard permits certified 2.0 devices to operate at “**full speed**,” or 12mbps. Only certified “**high speed**” 2.0 devices support the full 480mbps data rate, a semantic point that has caused considerable consumer confusion.

While the semantic difference is small, the performance difference is great. Designers and purchasers of DMPs should be careful to select systems that incorporate USB 2.0 high speed interfaces. A full speed USB interface is adequate for playback of songs from an attached mobile player or portable storage device, but a 12mbps transfer rate is completely inadequate for synchronization, indexing and content management.

---

<sup>1</sup> Source: Instat research report “USB 2006: Here Comes Wireless (#IN0602962MI),” April 2006.

A 12mbps interface does not support effective user browsing (i.e. content review and management) of an audio database stored on a portable device. A



collection of 1000 songs, organized into a single directory, with associated meta-data to identify artist, album, genre, track length and user-defined playlist, can take more than 25 seconds to browse through a 12 mbps USB 2.0 full speed interface, while a 480 mbps high speed interface can browse the same 1000 songs in less than 5 seconds (see accompanying chart). Only a high speed 480mbps interface can offer users the kind of instant browsing performance they have come to expect from their experience with computer-based and mobile audio players.

Consumer audio equipment with embedded DMP technology will increasingly incorporate local storage, such as hard-disk drives (HDD) or flash memory, to archive digital audio files. A 480 mbps high-speed USB interface would enable audio file transfers between internal HDDs and external memory sticks or portable players for music synchronization or backing up of valuable music files at data rates that are 40X faster than a 12mbps full speed USB.

Satisfactory user-browsing and file transfers both require a high-speed USB implementation. Although a high speed USB interface necessitates a more complex, less concise, mixed-signal PHY silicon design, a DMP that does not support 480mbps USB capability will produce a profoundly unsatisfactory user experience.

Finally, not all USB implementations are mutually compatible, even if they are fully standard-compliant. The USB interface utilizes well-defined SCSI commands. But during device initialization and handshake, the sequencing, repetition and delay time of these commands are not specified by the USB standard. Approximately 70% of USB peripheral devices employ a fairly obvious initialization routine, but nearly a third of certified USB devices on the market use unconventional—but standard-compliant—sequences of the INQUIRY, READ FORMAT CAPACITIES and REQUEST SENSE commands. These three commands must be repeated in various combinations to complete initialization. The discovery and implementation of all possible command sequences to assure USB host compatibility with 99% of all certified peripheral devices requires an extensive trial-and-error investment. Naturally a DMP designer that fails to invest in widespread USB compatibility testing will produce a system that will generate an unacceptable number of product returns and customer service calls.

## **Conclusion**

Adding a USB interface to a DMP audio system allows consumers to enjoy the music they want, when, where and how they please. Every mobile player and many mobile phones now have USB capability, which makes this functionality critical for all DMP and networked consumer electronics that want to offer user interoperability within this product eco-system. USB provides connectivity options even when no network is available. A USB port simplifies music sharing among friends and music archiving on portable storage devices. DMP designers can maximize user utility and customer value by insuring that their selected USB implementation fully meets market and user expectations for functionality, speed and compatibility.

---

Authors: Marcel Dasen and Spencer Horowitz

BridgeCo EUROPE  
Ringstrasse 14  
CH-8600 Duebendorf  
Zurich, Switzerland  
+41 44 802 33 33  
[info@bridgeco.net](mailto:info@bridgeco.net)

BridgeCo USA  
+1 714 328 7706  
[sales-usa@bridgeco.net](mailto:sales-usa@bridgeco.net)

BridgeCo JAPAN  
[Sales-japan@bridgeco.net](mailto:Sales-japan@bridgeco.net)

BridgeCo Taiwan  
+886 918 260 913  
[sales-apac@bridgeco.net](mailto:sales-apac@bridgeco.net)