High Resolution Technologies
Customer Case Study

You have high quality digital music on your computer, and the option of downloading more. At the same time you have an investment in good audio equipment: how do you link the two? The output from the normal analog audio socket is not anywhere near the quality of the audio system, nor does it reflect the quality of the music stored in the system. Since one of the reasons for keeping material on a personal computer (MAC or PC) or on a dedicated storage device, is to avoid having the problems of storing and finding CDs, you don't want to burn the music to discs. So a new class of device, which takes streamed USB output and converts it to audio, has been developed to fill the gap.

"... without the XMOS reference design we could never have finished the project in time for CES…"

Simple enough in concept, and there are even existing chips that will do most of this. But to produce a result that will match the quality of your audio system takes a lot more. High Resolution Technologies (HRT), from the world entertainment centre, Los Angeles, is on a mission to provide high quality audio streamers. Its first products in this area, the Music Streamer, Music Streamer+ and Music Streamer Pro, introduced from spring 2009, are already setting the benchmark for this device class. But then, in August 2009, Apple launched Snow Leopard, (MAC OS 10.6) with support for USB audio device class 2.0, and the landscape changed.

Within the overall USB structure, USB device classes are the specifications for managing different types of objects, such as mass storage devices, printers and human interface devices such as mice and keyboards. The USB audio device class version 2.0 has been around since 2006, but only reached the mass market with the Snow Leopard release. It is still not supported on Windows, although third party drivers are available. Where audio version 1.0 ran on USB 1.1 (Full Speed USB), with a data rate of 12 Mbps, version 2.0 is supported on USB 2.0 (Hi-Speed USB). This has a theoretical maximum speed of 480 Mbps, which means that it can provide 24 bit, 192 KHz audio in up to 24 channels. (1.0 is up to 3 channels at 48 KHz). Clearly Audio 2.0 provides a much greater match for the higher end of audio equipment, so once it started to become generally available HRT was naturally keen to develop new streaming products that exploited the standard. But there was no off-the-shelf device for processing Audio 2.0, and it was not until HRT discovered the XMOS USB Audio 2.0 Reference Design that they were able to proceed.

About High Resolution Technologies

High Resolution Technologies (HRT), based in Los Angeles, is dedicated to the development of music streaming devices. The company's founders, CEO Mike Hobson and CTO Kevin Halverson have a track record at the very high end of audio. Mike's Classic Records has been producing vinyl pressings and CDs from the original recording tapes, covering a wide range of musical styles, for over 15 years. Kevin's Muse Electronics has been around for over 20 years, building players and amplifiers of the very highest quality.

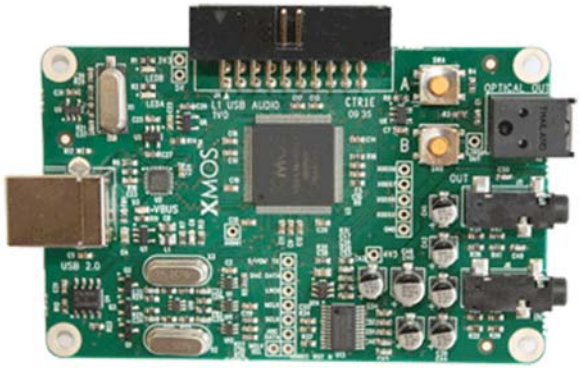
HRT was launched in 2008 with several company aims. The first is to provide the best quality devices for streaming music from computers and servers into audio systems. A secondary objective is to demonstrate that adding a higher quality source can improve even medium quality audio systems, and educate a new generation in the benefits of high quality audio.

The company has received rave reviews for its Music Streamer family, from some of the toughest audio critics.

Architecture

Within the Music Streamers are two functional blocks, the USB processing, discussed in more detail below and the digital to analog conversion, which is largely carried out by an off-the-shelf device. They are electrically isolated, so that any electrical noise from the source computer, which can be an electrically noisy environment, doesn't reach the analog output. The isolation is achieved through isolation amplifiers and a synchronous DC to DC power supply. The whole device draws its power from the USB cable.

For its first products HRT had used an off-the-shelf device (TI's TAS1020B) for managing the USB audio functions. This includes a standard 8052 core and HRT-developed firmware, in assembly code, for this to handle routine management tasks, including communicating with the host computer. For USB Audio 2.0 there were no immediately available silicon devices, so in the fall of 2009, HRT was having difficulty identifying a route to implementing the standard when it was introduced to XMOS and the USB Audio 2.0 Reference Design.

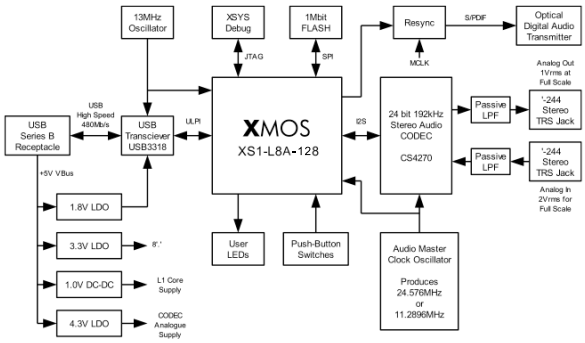


At the end of October, HRT took delivery of a reference design and an XMOS development system and by January 2010 was able to demonstrate a prototype of a USB Audio 2.0 streamer, the Music Streamer HD, at the Consumer Electronics Show in Las Vegas. The first product shipments were made at the end of March 2010 – a completely new system in well under six months.

The solution

The XMOS base product is the xCORE, a multicore microcontroller, which runs multiple real-time logical processing cores simultaneously and is programmed using C, C++ or XC, a set of extensions to C to support concurrency. The multicore approach means that performance can be increased by simply adding more cores; xCORE devices are available with 4, 6, 8, 10, 12 16 cores.

The USB Audio 2.0 Reference Design XS1-L1 Edition uses a single core XS1-L1 chip on a credit card sized board. The complete source implementation is available from XMOS. The kit also includes an XTAG-2 Debug Adapter that provides JTAG control, system reset and processor debug.



With the increased performance available from USB Audio 2.0, and the power of high-level languages, HRT made the decision to completely rewrite the firmware that runs in the 8052, abandoning assembler for C and adding new features. For example, USB Audio 2.0 allows the Music Streamer HD to use higher data rates for improved sample rates, and to address multiple channels for surround sound.

The whole project, while intense, was less painful than HRT had expected. "The reference design, and the support we got from XMOS combined to make it a much faster and easier experience than we expected to implement USB 2.0 and Audio 2," commented Kevin Halverson.

Looking forward

Kevin sees multiple advantages in moving from the special purpose TI part to the general purpose XMOS xCORE device. "I have transferred the firmware to a software person, who is already netting us end results faster than when I was writing the firmware in assembler. That leaves me free to concentrate on hardware design, and I expect that we will be able to introduce new products quickly for specific market segments."

Kevin is already thinking about the benefits of using a dual-tile device with 16 cores, as he can see a number of applications where the additional processing power would be a distinct advantage.

"The XMOS reference design, the support from the people, and the basic architecture of the XCore have all combined to give us a whole new way of looking at future products."