

# how it works

**DIGITAL AUDIO IS MORE THAN THE MUSIC PLAYED ON PCs, PDAs, OR SOLID-STATE WALKMANS STRAPPED TO JOGGERS' HIPS. SONIC-SUPPLIED INTERNET APPLIANCES CAN TRANSPORT THE TUNES TO EVERY ROOM IN THE HOUSE.**

## Audio receivers tune in to binary broadcasts

By Brian Dipert, Technical Editor

**Y**OUR POTENTIAL CUSTOMERS have already got a couple of PCs networked together over TCP/IP, using Ethernet or HomePNA. They've ripped a few dozen

CDs' songs into MP3, WAV, or WMA files, and perhaps supplemented their digital-audio collections with a little Etree or Napster browsing. They'd like to listen to this digital audio not only on portable players or fidelity-deficient computer speakers but also on their stereos. But their PCs aren't in their living rooms. Running a PC sound card's analog-line-level output or digital S/PDIF output a hundred feet or so to a stereo not only requires unsightly cabling, it probably won't even produce an usable audio signal at the receiving end. What can you do to solve your customers' problems and, in the process, sell them your products? Voyetra Turtle Beach, along with competitors such as iObjects, Panja, and SonicBlue, thinks it has the answer.

One year ago at Microsoft's Windows Hardware Engineering Conference, Voyetra Turtle Beach (a company best known at that point for its PC sound cards) unveiled a prototype of its \$299.95 AudioTron network digital music player (Figure 1). The terms "network" and "player" hint at what the AudioTron developers did (and, equally important, resisted doing) in designing and refining the product to target a specific price and customer base, and in time for end-of-last-year production. AudioTron, resold by Gateway as the Connected Music Player, doesn't locally store digital audio files, although the chassis has sufficient reserved room for a hard drive in a potential variant with expanded features. Nor



**Figure 1**

Voyetra Turtle Beach designed AudioTron to fit right into a home-audio-equipment rack.

does it create (that is, encode) the files; such capability would require a powerful microprocessor or dedicated encoding logic, either of which would negatively impact the bill-of-materials cost. Instead, for file storage and creation, AudioTron relies on the PCs that Voyetra Turtle Beach assumes are also in consumers' homes, and AudioTron transfers this audio data to itself over Ethernet or HomePNA 2.0 for subsequent decoding (Figure 2).

AudioTron's form factor enables it to seamlessly fit into a home-stereo equipment stack, another clue as to what the product does and doesn't do. You'll find no power amplifier inside the unit. Instead, Voyetra Turtle Beach provides both analog line and optical S/PDIF digital outputs, feeding a separate stereo amplifier or integrated receiver. At first glance, this decision might seem to prohibit AudioTron's use in "clock-radio-like" applications for rooms that don't already have stereos, such as kitchens or bedrooms. However, although AudioTron doesn't contain a built-in 10W amplifier like the one in SonicBlue's Rio Digital Audio Receiver, you can still hook

it up to a set of powered speakers. AudioTron *does* contain a low-power headphone amplifier, at least partially because consumers expect home-stereo gear to have headphone jacks (regardless of whether the consumers use them), according to company officials.

Voyetra Turtle Beach's inclusion of a high-quality digital S/PDIF output wouldn't make much sense if AudioTron decoded only degraded-quality lossy-compressed audio formats, such as the currently supported MP3 and WMA. (Support for more formats is on the way, potentially including digital-rights-management systems.) However, AudioTron also plays back uncompressed 32- and 44.1-kHz-sampled WAV files. In conjunction with S/PDIF, this capability enables the company to target more sophisticated, less-cost-conscious audiophiles. I wonder, though, why AudioTron doesn't provide both optical and coaxial S/PDIF outputs, in case the mating receiver has only coaxial inputs, or in case the receiver's optical inputs are already in use.

When connecting AudioTron to the network, you can use DHCP or designate an IP address. AudioTron then automatically scans the drives of other LAN-connected clients, looking for applicable digital audio files. By default, to simplify the search process and control the number of search results, AudioTron looks for files only in directories or folders named Audio, Music, My Music, and Playlist. The most recent firmware release allows users to override this restriction. AudioTron also supports the ability to enter one, shared drive-and-folder password (for Windows 9x and ME clients) and user-name-and-password combination (for Windows NT4 and 2000 clients). Voyetra Turtle Beach's approach enables AudioTron to access music files stored on any network-connected computer, regardless of its OS. In a home-computing world dominated by Microsoft (and to a lesser extent, Apple), such platform flexibility has limited value. But it does save you from having to install special music-server software on each computer, a task that both Panja's BMP-100 Broadband Music Player and SonicBlue's Rio Digital Audio Receiver (resold by Dell) require.

AudioTron classifies the music files it finds by title, artist, album, or genre, using embedded identifier tags. Where tags don't exist, it uses the filename as the title. Via either front-panel controls or the supplied wireless remote, users can scroll through lists of songs, whose information appears on the small LCD. Users can also assign groups of songs to one of four presets and one of 16 favorite remote-control buttons. AudioTron doesn't constantly monitor the network; if users move or delete files, or add or remove computers, a lengthy subsequent network rescan must occur. If users just add files to existing computers, though, AudioTron also offers a briefer "check for new music" feature. And if precomposed playlists exist on the computer in M3U or PLS formats, AudioTron will also play those.

How much additional per-unit cost would the company have incurred if it had added a composite video output for optionally displaying a playlist on a television (which is probably right next to customers' home stereo systems)? As it stands, the two-line LCD makes playlist creation and navigation somewhat cumbersome. More practical was Voyetra Turtle Beach's decision to forgo wireless LAN connectivity (see **sidebar** "Cut the wires"). When the company began AudioTron's design, it was unclear whether 802.11b or HomeRF would become the dominant technology in the home.

AudioTron will stream WAV files only over 10-Mbit Ethernet, not over lower bandwidth HomePNA, and HomeRF would have had similar restrictions. An adjustable queue-buffer threshold setting compensates for brief network hiccups, but it would be unable to overcome a several-minute-long and broad-frequency-range microwave-oven cooking session. (The microwave oven in my house will, when "broadcasting," bring my 802.11b network to its knees.) And Hollywood is still uncomfortable with the idea of wireless digital broadcasts that nosy neighbors can potentially tap into, no matter how robust the encryption is purported to be.

AudioTron's processing "heart" is a Cirrus Logic EP7312 ARM-based CPU (**Figure 3**). Initial AudioTron prototypes em-

## CUT THE WIRES

At least for the near future, Voyetra Turtle Beach feels it's inappropriate to add wireless network connectivity to AudioTron. Ironically, however, the company does have a wireless audio PC companion in its product line, the \$99.95 Sonic Link. Sonic Link comprises the company's PC-based AudioStation software, a wireless transmitter that connects to the PC's sound-card line-out jack (and replicates the jack for use by the PC's speakers), and a companion wireless receiver that plugs into an audio amplifier's or receiver's auxiliary inputs. A wireless remote control, whose

receiver connects to the PC's serial port, controls the AudioStation software and acts as a universal remote for TVs, VCRs, and other consumer-electronics gear.

Sonic Link enables your stereo system to play any audio content that the PC can decode. As such, it's not limited to only a few audio formats; it lets you enjoy streaming audio from numerous Web sites and Internet radio stations, and encrypted material is no problem if you've obtained appropriate access rights at the PC. However, because the PC, not the audio receiver, is decoding the audio, Sonic Link requires

a higher-performance PC than does AudioTron.

Other downsides? The biggest Achilles' heel of Sonic Link is the wireless link. Voyetra Turtle Beach chose to use the 2.4-GHz band, which currently isn't excessively crowded (unlike 900 MHz, which is inhabited by cordless phones and numerous other wireless devices). Jensen's and other companies' 900-MHz-based audio-broadcast units are reported to have poor range and excessive dropouts.

Sonic Link *does* support user alteration of its default broadcast channel, to evade frequency con-

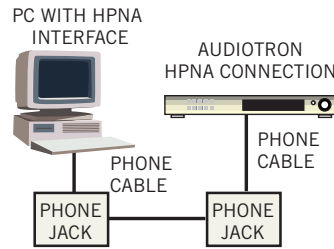
flicts with newer 2.4-GHz cordless phones and X10, HomeRF, 802.11, and Bluetooth networks, for example. But, still, that infamous microwave oven sits in most homes, and its operation will likely clobber nearly every Sonic Link connection. Consumers are intolerant of equipment that doesn't "just work," and despite warnings about microwave ovens in Sonic Link literature, the company admits that it sees more expensive technical-support calls and customer returns than it would like to.

ployed the prior-generation EP7212, which interfaces to EDO DRAM; the EP7312 uses the more common SDRAM. Both microprocessors have sufficient “muscle” to decode all planned audio formats. The EP7312’s built-in clock divider saved Voyetra Turtle Beach a few dollars of system cost, according to chief technical officer Howard Brown and president and CEO Carmine Bonanno, and the EP7312 also integrates a column-and-row-matrix keypad controller.

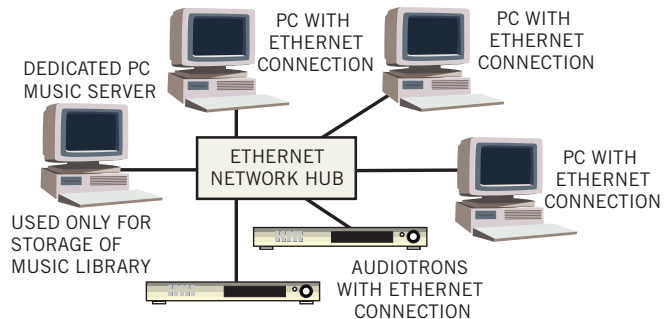
Voyetra Turtle Beach’s prior relationship with Cirrus Logic was a factor in the EP7x12 selection. (Cirrus Logic supplied the DSP in Voyetra Turtle Beach’s \$99.95 Santa Cruz sound card, for example.) Another factor was the diverse selection of already-available ARM-optimized software (including an MP3 decoder). Microsoft’s public position is to offer a no-cost license for the WMA decoding algorithm as long as it runs on a Microsoft-supplied operating system. Such is not the case with AudioTron. Voyetra Turtle Beach declined to discuss the WMA licensing terms it negotiated with Microsoft. Currently, AudioTron does not support playback of security-enabled WMA files, whose access rights are restricted to the PC on which they reside.

AudioTron includes 16 Mbytes of DRAM, a density that’s overkill for virtually all possible consumer-operating scenarios. The availability of the most cost-effective density DRAM components fundamentally drove this decision. Audio decoding algorithms use only a small percentage of this memory. Some of it (40 seconds worth at a 128-kbps incoming bit rate) acts as a queue buffer to smooth network-packet hiccups; most of it acts as the network-file database. Depending on the number of embedded tags per file, AudioTron can archive information on as many as 10,000 audio tracks.

Voyetra Turtle Beach considered putting virtual-3-D audio-synthesis capabilities into AudioTron, similar to the Qsound, Spatializer, SRS Labs, or proprietary algorithms built into many DVD players, but at the end of the day decided to leave them out. The company didn’t want to overwhelm the EP7312 with the combination of virtual-3-D postprocessing and decoding of future audio formats with a now-unknown processing burden. Virtual-3-D audio also isn’t highly valued by the audiophile “early adopters” that the company felt would represent a significant percentage of AudioTron’s potential customer base. And pseudosurround-sound capabilities are now built into many audio receivers, making their presence on AudioTron re-



**Figure 2**



**AudioTron topologies range from extremely simple (top) to very complex (bottom), running under both Ethernet and HomePNA networks.**

dundant and, therefore, unnecessary.

Initial AudioTron prototypes supported USB, but Voyetra Turtle Beach dropped the interface from the final production design. Limited bandwidth and excessive, unpredictable latency in multiple-peripheral topologies might preclude WAV playback, and configuration was problematic with early (supposedly USB-aware) Windows operating-system versions. This situation will not surprise anyone who has attempted to connect USB-interface speakers to his or her PC. IEEE 1394 would have solved the bandwidth issue, but the incremental cost wasn’t justified by the questionable market opportunity, given 1394’s limited inclusion in PCs. A \$20 Ethernet card and a CAT5 cable, Voyetra Turtle Beach believes, will deliver a better user experience than USB or 1394, with far fewer setup hassles.

The company also initially considered but later dropped the idea of an internal expansion port (for example, to add audio-recording capability as an end-user upgrade). The connector cost wasn’t the primary issue, although the number of required address, data, and control signals would have been significant. Brown and Bonanno observe that engineers are great at coming up with an infinite number of “what-if” potential features, but reality hits hard when the design and manufacturing personnel have to together figure out how to test each and every one of those great ideas in a low-cost, high-volume system-manufacturing environment. And anyway, the

## FOR MORE INFORMATION...

For more information, go to [www.ednmag.com/info](http://www.ednmag.com/info) or contact the following manufacturers directly. And please let them know you read about their products in *EDN*.

**Voyetra Turtle Beach**  
1-914-966-0600; [www.voyetra-turtle-beach.com](http://www.voyetra-turtle-beach.com)  
Enter No. 365

**OTHER COMPANIES MENTIONED**  
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**Apple Computer**, [www.apple.com](http://www.apple.com)  
**Cirrus Logic**, [www.cirrus.com](http://www.cirrus.com)

**Dell**, [www.dell.com](http://www.dell.com)  
**Etree**, [www.etree.org](http://www.etree.org)  
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**Intel**, [www.intel.com](http://www.intel.com)  
**iObjects**, [www.iobjects.com](http://www.iobjects.com)  
**Jensen**, [www.jensen.com](http://www.jensen.com)  
**Microsoft**, [www.microsoft.com](http://www.microsoft.com)  
**Napster**, [www.napster.com](http://www.napster.com)  
**Panja**, [www.panja.com](http://www.panja.com)

**PortalPlayer**, [www.portalplayer.com](http://www.portalplayer.com)  
**QSound**, [www.qsound.com](http://www.qsound.com)  
**SonicBlue**, [www.sonicblue.com](http://www.sonicblue.com)  
**Spatializer Audio Labs**, [www.spatializer.com](http://www.spatializer.com)  
**SRS Labs**, [www.srslabs.com](http://www.srslabs.com)



**Figure 3**

AudioTron's chassis reserves room for future function expansion, specifically a hard drive for recording and local storage.

expansion concept doesn't work well in the generally closed-box consumer-electronics world.

AudioTron uses flash memory for firmware storage. Voyetra Turtle Beach has already taken advantage of the in-system upgrade capability to release one firmware update, which added several configuration options and fixed a number of minor bugs. Users place the new firmware file in one of the PC directories in which AudioTron searches for audio files, then they initiate an upgrade through a front-panel button sequence. The company plans to add streaming-Internet-audio support later this year, minimally for WMA format content. Panja's Broadband Audio Receiver already supports limited Internet-audio-streaming capability but only from the my.MP3.com service and only under a \$9.95/month AudioBlast subscription model. Not only are the potential packet-delivery delays longer and the out-of-order delivery probability higher with Internet delivery (versus LAN intranets), but the streaming-audio receiver must also comprehend and correct for occasional dropped packets.

As briefly mentioned earlier, if AudioTron were both an audio playback unit and a recording "tape deck," the bill-of-materials cost would be significantly higher. A more expensive processor, such as Cirrus Logic's EP9312 or PortalPlayer's Tango, would be required to run the far more MIPS-intensive encoding algorithms (references 1 and 2). Voyetra Turtle Beach would also need to add a hard drive or other mass-storage device and its companion controller. And there might also be a negative impact on the required memory budget. The company seems content, at least for the moment, to buy into Intel's Craig Barrett's and Microsoft's Bill Gates' visions of peripherals throughout the home, connecting to and leveraging the resources of ever-more-powerful PCs. □

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#### REFERENCES

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2. Dipert, Brian, "Audio encoder/decoder hides hardware help," *EDN*, Aug 3, 2000, pg 26.