PHILIPS

WHITE PAPER: *New PC Sound Requirements*

Attacking MP3 File Compression and PC Fidelity Input/Output for HOLISTIC Listening Improvement

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Traditionally, sound in personal computers has not really been about listening quality. Beeps, chirps and other simple tones used in personal computers were originally created to augment various commands, not to support an alternative listening experience. Used primarily as audio cues, personal computer sounds were tied to games, productivity applications or used as a single element in a brand, as in the Microsoft® "chord" that plays upon the opening of the Windows® operating system.

Today, however, PC sound is going through a renaissance. Because of the proliferation and increasing sophistication of personal computers – and the continued migration of digital media into the home in general – consumers now want to listen to their computers in much the same way they listen to their stereos or TVs. Now, consumers want to improve the quality of entertainment experiences that are *uniquely and conveniently* provided by their computers.

Manufacturers are responding. New computer introductions are emerging onto the market that position the PC as the staging area for home entertainment. In addition to enhanced music capability, these PCs have TV tuner cards, Personal Video Recorders (PVR), online program guide, etc.

Similarly, in the past the standalone sound card market was relegated to serving the needs of vertical segments like audiophiles and gamers (who were willing to pay quite a bit for additional sound capability). Today's market is driven by mainstream consumers.

The Importance of MP3.

It should be noted that the PC entertainment trend has been greatly accelerated by the MP3 file format. In fact, MP3 files have revolutionized consumer music. Recent research* indicates that one-fifth of Americans, or about 40 million people, have downloaded digital music from file-sharing services.

The obvious benefit of MP3 files is that they are compressed to make Internet transmission easier. Using advanced compression algorithms, the file shrinkage is significant, usually at least by a factor of 10. With MP3, Internet transmission times for a standard song track on a CD were reduced from hours to minutes.

However, since considerable data is removed in the copying process, the MP3 format is usually described as "near CD quality." Conventional wisdom says that the data loss does not affect the listening experience of the average user (i.e., sounds that the human ear can't hear, louder noises are emphasized). This, however, was a generous viewpoint established in light of the significant offsetting benefits of reduced file size and the accepted usage models of PCs a couple of years ago. The fact is, the sound quality of MP3 files *is substandard* when compared to CDs and home entertainment systems in general. New standards are emerging for PCs based on the consumer electronics usage model.

New Requirements.

The emergence of a mainstream market for CD-quality PC sound should be good news for sound card manufacturers. But most sound card manufacturers remain focused on optimizing the processing capability of their cards; and, given the state of sound card technology in 2002 (16-bit/48KHz data streams remain the common standard), it's clear they are struggling to make noticeable improvements – even to their traditional audience of audiophiles and gamers. Focusing on changing bit depths and sampling rates has met the laws of diminishing

returns, and this approach no longer improves sound quality in a meaningful way.

Most surprisingly, this traditional view of sound card functionality *has not attempted to address or compensate for the loss of data in MP3 files*. Clearly, the MP3 format (including the new mp3Pro format) will continue to play a major (if not the central role) in digital music for years to come. Add to this the new standards evolving in pricing, ease-of-use and the net effect of the listening experience in general, and you have a market in which consumer sophistication and expectations have outpaced product innovation.

Improving PC sound is no longer a matter of simply optimizing the sound card itself – it's a matter of re-defining the listening experience associated with a personal computer. Sound card manufacturers need to get out from under the hood of the car, as it were, and consider where the car is going.

Consumers bring many more variables to the decision purchase mix vs. vertical markets, each of which must be addressed. These are:

1. Ease-of-use
2. Reproduced sound quality, especially as it relates to MP3 files
3. Price
4. Input types
5. Output variables
6. Environment

Clearly, managing all of these variables is difficult. Philips Electronics has devoted one of its research and development facilities to this challenge. Located in Tempe, Arizona, the Philips Audio Lab is a centerpiece to the development of sound products for the personal computer and digital home marketplace. One of the latest innovations from those development efforts are new sound card products based on the concept of *Holistic Sound Management*, which is described below.

New Approaches.

To achieve real innovation – or more specifically, audible sound differentiation – and put the productivity-oriented personal computer on a par with home entertainment or

powerful game-focused systems, a new way of thinking about PC sound was required.
Managing a wide range of variables is called *Holistic Sound Management*. While MP3 is important, there is still a surprisingly large number of digital file formats, each with its own unique advantages and disadvantages. There are an infinite number of speaker and headphone combinations. And, whatever the speaker arrangement, the nature of the room plays an important role.

Holistic Sound Management.

Recently, Philips announced the availability of innovative PC sound technology capable of dramatically improving the sound quality of personal computers. This technology is now available to personal computer OEMs as well as current PC owners, and was developed to address new requirements of fast-growing PC entertainment applications.

The new Philips technology is called *Sound Agent 2*. Sound Agent 2 uses sophisticated algorithms to analyze sound along two dimensions: the source of sound, which can be *any* source type, and the room or headphones where the sound is going to be played. Combining input and output with the sound card itself results in high-quality total *holistic* sound optimization.

Importantly, the end-user also has a means of easily identifying and manipulating variables that affect sound quality in context of their particular listening experience. So, while Sound Agent 2 will automatically optimize sound quality along the two dimensions described above, the user also has the option of tweaking and adjusting sound to suit his or her unique needs – via an easy to use graphical user interface.

Sound Agent 2 performs real time *logic functionality* that determines where audio streams are coming from and where they are going at any given moment. This control center "brain" acts as a media traffic cop – analyzing, processing and directing multiple audio streams independently and simultaneously. The end result is fully optimized PC audio fidelity, in any listening environment, and with any equipment.

Sound Agent 2, and the underlying Intelligent Media Processing (IMP) technology, is available to PC users bundled with two new Philips retail sound cards, the Dynamic Edge 4.1 with quad surround, and the Sonic Edge 5.1 with 5.1 Channel

Surround. Both cards include three governing feature sets for managing sound holistically:

1. *Intelligent Media Processing (IMP):* The Philips software foundation that constantly monitors the type of sound input and renders it according to output.

2. *Compelling 3D virtualization:* Technology developed by QSound Labs for Sound Agent 2 creates the absolute best 3D audio experience for any headphone, stereo speaker or multi-channel speaker system. State-of-the-art algorithms eliminate the need for cross-talk cancellation found in many solutions from other manufacturers. The end result is an ultra-wide "sweet spot" for strong positional perception regardless of head movement and positioning, allowing listeners to enjoy a true 3D surround experience with two, four, or more speakers in any environment.

3. *Comprehensive API support:* Both cards include extensive compatibility to existing standards, such as DS3D, EAX 2.0, and A3D 1.0.

The Sonic Edge 5.1 also includes:

1. *5.1 Channel Surround from any source material:* Stereo sources from CDs, MP3s, and PC games are transformed into 6 full channels of true surround sound using QSound's exclusive QMSS 5.1 technology. While other solutions simply mirror the front stereo speakers in the rear channels, QMSS analyzes each incoming signal and automatically approximates the location of where each individual sound should be in a surround environment. The result is a full 360-degree wrap-around sound experience from all sound sources.

2. *QSizzle and QRumble to supercharge MP3's:* Uniquely provides an energy boost to MP3 files that helps restore compressed digital music to its original fidelity, by compensating for lost harmonic detail (see expanded technology description "*Attacking MP3 Format Limitations*"). MP3 files are have a notoriously flat sound. Truly adaptive, this technology features active multi-band filtering that continuously monitors input signals and makes adjustments automatically.

3. *Virtual 5.1 Channel Surround:* From 5.1 channel sources such as multi-channel software DVD players, QSurround virtualizes each channel for dynamic reproduction through stereo speakers. In addition, QSurround enhances playback through multi-channel 5.1 speakers for a seamless and more immersive surround experience.

Attacking MP3 Format Limitations.

QSizzle and QRumble are audio frequency response modifiers. This technology is in the same general category as tone controls and equalizers (i.e. filters). However, whereas conventional filters are static, QSizzle and QRumble are *active*.

Static filters apply a fixed change to the input signal according only to their user settings, without regard to the nature of the sound input signals. For example, if a bass tone control is set by the end user to provide a given boost amount, this boost amount, and the shape of the filter curve (boost vs. frequency) remain constant over time, regardless of the instantaneous characteristics of the audio input signal itself. In a sense, the filter "ignores" the signal and blindly makes its assigned modification.

Static filtering must be judiciously applied. With more dramatic filtering, i.e. high boost levels, a truly artificial tonal characteristic is imparted. This is perceived by the listener (consciously or unconsciously, according to their level of sophistication) as being systemic – that is, separate and independent of the content. Second, increased boost also carries a higher risk of overload distortion, requiring more frequent user adjustments to deal with extremely variable content.

QSizzle and QRumble are *active* filters – their response varies dynamically, in real time. Unlike the classic bass and treble tone controls, both QSizzle and QRumble are composed of multiple independent processing channels. Each channel applies variable dynamic emphasis in accordance with the audio input signal. In direct contrast to static filters, user settings for QSizzle and QRumble provide guidelines for the desired effect, rather than fixed rules. The instantaneous degree and frequency weighting of the emphasis are controlled *by the input signal itself*. This use of content to control emphasis *results in highly correlated, natural sounding*

enhancement. Furthermore, it permits greater levels of boost without objectionable side effects. Obviously, QSizzle and QRumble substantially reduce the need for user readjustment.

QSizzle and QRumble are particularly effective in the treatment of digital audio content that has been encoded using data compression algorithms such as MP3. Since compression is often applied to a degree that results in audible degradation, content can sound flat and lifeless due to the loss of frequency content and dynamic range.

Static filters cannot help – and can even worsen – the dynamic range problem, and tend to sound artificial (i.e. "boomy" or "shrill") at higher settings. In contrast, the active dynamic spectral emphasis provided by QSizzle and QRumble effectively compensates for the negative side effects of digital compression in a natural, content-dependent manner. QSizzle brings liveliness and sparkle to midrange and upper frequencies, while QRumble restores warmth and punch to the low end of the spectrum.

Usage Example.

To illustrate the *Holistic Sound Management* capability of Philips Sound Agent 2 and its sound cards, consider this complex (but not unrealistic) example:

> *Joe is playing Half Life, a game that supports 3D positional audio via Microsoft's DirectSound3D API. Game sounds are being accurately placed around him using DS3D and EAX support built into Sound Agent 2, and are being rendered (sound is being created) through Joe's 5.1 speaker system with his Sonic Edge 5.1 sound card.*
>
> *At the same time, Joe is playing his favorite MP3 play list, with Media Player® in the background. Joe likes to listen to his own MP3 collection while playing games.*
>
> *The MP3 audio stream is automatically being processed from 2-channel stereo into 5.1-channel surround simultaneously -- using Sound Agent 2's QMSS 5.1 feature -- giving Joe an optimized combination of game audio mixed with music for his own "custom" experience.*

Joe also likes to interact with other people online. While the music is playing, he uses his PC microphone to talk with his online gaming friends via software that provides IP based Internet chat. His friends create mono voice streams that are processed by Sound Agent's QMSS 5.1 technology that is mixed with the other multi-channel streams and" localized", so Joe feels like the voices of his friends are immersed in the actual soundtrack of his online adventures.

In the midst of all this, Joe's friend Mike steps into his room and asks if Joe wants to check out his new Spiderman® DVD. Joe, not wanting to exit his online game and playlist -- but who wants to see the DVD -- reduces the music volume, then launches a multi-channel software DVD player and plays the first chapter of Spiderman. Again, rendered through Sound Agent 2 in enhanced 5.1-channel QSurround, Joe adds a reverb Theater preset via QSound's Environmental Modeling (QEM) technology to the DVD playback. The result is a custom, in-the-theater like experience.

As Joe and Mike watch Spiderman, Joe is still monitoring his game in the background to make sure he is "in the action"...

No other sound card manufacturer today can address such input and output complexity.

Platform strategy extends to other products.

IMP is a software architecture that can be utilized in a wide range of consumer devices. With powerful, affordable products emerging for home use including servers (PC and otherwise), wireless media, new TV sets, web tablets or "smart displays", the home environment will become increasingly complex and diverse. Sound Agent 2, and the underlying IMP technology, represents an important and highly extendable user interface *platform* for this increasing broad range of home entertainment products.

Affordable pricing.

Unlike vertical markets, mainstream consumer demand requires that the sound cards be less that $50 (less than 10% of the average PC price). As a result, the suggested retail price of the Sonic Edge 5.1 is well under $50 (the Dynamic Edge 4.1 is half that).

Philips.

Royal Philips Electronics has been marketing technology into the home for over 100 years. Its core strengths in driving standards, innovation, consumer expertise, audio and video intellectual property and extensive display technology allows Philips to uniquely bridge the gap between the personal computer and digital homes and vehicles.

The Company is one of the world's biggest electronics companies and Europe's largest, with sales of $28.8 billion (EUR 32.3 billion) in 2001. It is a global leader in color television sets, lighting, electric shavers, medical diagnostic imaging and patient monitoring, and one-chip TV products. Its 184,000 employees in more than 60 countries are active in the areas of lighting, consumer electronics, domestic appliances, components, semiconductors, and medical systems. Philips is quoted on the NYSE (symbol: PHG), London, Frankfurt, Amsterdam and other stock exchanges.

For additional information on any of the technologies in this article, please contact Dennis Johnson at +1-480-752-6096 or dennis.w.johnson@philips.com.

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