**How Sound Cards Work**

Before the invention of the sound card, a PC could make one sound - a beep. Although the computer could change the beep's frequency and duration, it couldn't change the volume or create other sounds.

At first, the beep acted primarily as a signal or a warning. Later, developers created music for the earliest PC games using beeps of different pitches and lengths.

Fortunately, computers' sound capabilities increased greatly in the 1980s, when several manufacturers introduced add-on cards dedicated to controlling sound. Now, a computer with a sound card can do far more than just beep. It can produce 3-D audio for games or surround sound playback for DVDs. It can also capture and record sound from external sources.

­ In this article, you'll learn how a sound card allows a computer to create and record real, high-quality sound.

**Analog vs. Digital**

Sounds and computer data are fundamentally different. Sounds are analog - they are made of waves that travel through matter. People hear sounds when these waves physically vibrate their eardrums. Computers, however, communicate digitally, using electrical impulses that represent 0s and 1s. Like a graphics card, a sound card translates between a computer's digital information and the outside world's analog information.

**Sound is made of waves that travel through a medium, such as air or water.**

The most basic sound card is a printed circuit board that uses four components to translate analog and digital information:

* An analog-to-digital converter (ADC)
* A digital-to-analog converter (DAC)
* An ISA or PCI interface to connect the card to the motherboard

Input and output connections for a microphone and speakers

Instead of separate ADCs and DACs, some sound cards use a coder/decoder chip, also called a CODEC, which performs both functions.

**ADCs and DACs**

Imagine using your computer to record yourself talking. First, you speak into a microphone that you have plugged into your sound card. The ADC translates the analog waves of your voice into digital data that the computer can understand.

The number of measurements per second, called the sampling rate, is measured in kHz. The faster a card's sampling rate, the more accurate its reconstructed wave is.

If you were to play your recording back through the speakers, the DAC would perform the same basic steps in reverse. With accurate measurements and a fast sampling rate, the restored analog signal can be nearly identical to the original sound wave.

**Other Sound Card Components**

In addition to the basic components needed for sound processing, many sound cards include additional hardware or input/output connections, including:

Digital Signal Processor (DSP): Like a graphics processing unit (GPU), a DSP is a specialized microprocessor. It takes some of the workload off of the computer's CPU by performing calculations for analog and digital conversion. DSPs can process multiple sounds, or channels, simultaneously. Sound cards that do not have their own DSP use the CPU for processing. Memory: As with a graphics card, a sound card can use its own memory to provide faster data processing. Input and Output Connections: Most sound cards have, at the very minimum, connections for a microphone and speakers. Some include so many input and output connections that they have a breakout box, which often mounts in one of the drive bays, to house them. These connections include:

* Multiple speaker connections for 3-D and surround sound
* Sony/Philips Digital Interface (S/PDIF), a file transfer protocol for audio data. It uses either coaxial or optical connections for input to and output from the sound card.
* Musical Instrument Digital Interface (MIDI), used to connect synthesizers or other electronic instruments to their computers.
* FireWire and USB connections, which connect digital audio or video recorders to the sound card

Game designers use 3-D sound to provide fast-paced, dynamic sound that changes based on a player's position in the game. In addition to using sound from different directions, this technology allows realistic recreations of sound traveling around or through obstacles. Surround sound also uses sound from several directions, but the sound does not change based on the listener's actions. Surround sound is common in home theater systems.

Like a graphics card, a sound card uses software to help it communicate with applications and with the rest of the computer. This software includes the card's drivers, which allow the card to communicate with the operating system. It also includes application program interfaces (APIs), which are sets of rules or standards that make it easier for software to communicate with the card.

**Other Options for Sound Control**

Not every computer has a sound card. Some motherboards feature integrated audio support instead. A motherboard that has its own DSP can process multiple data streams. It may also support 3-D positional and Dolby surround sound. However, in spite of these features, most reviewers agree that separate sound cards provide better audio quality.

Laptops usually have integrated sound capabilities on their motherboards or small sound cards. However, space and temperature control considerations make top-of-the-line internal cards impractical. So, laptop users can purchase external sound controllers, which use USB or FireWire connections. These external modules can significantly improve laptop sound quality.

breakout box - коммутационный бокс (небольшое устройство, предназначенное для контроля и маршрутизации входящих и исходящих сигналов)