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## The Computer as High Quality Audio Source A Primer

These are exciting times of change in the music world. With CD sales dropping and downloaded MP3 music, streamed music and digital music players taking over there is no consensus for what the future will look like. It could make an audiophile and music lover despair. However, along with all of the change there are positive forces emerging in the market. Numerous sources of High Definition digital audio downloads have emerged on the WEB, great music mastered in high definition audio ranging from traditional CD rates of 16 bits at 44.1 KHz ranging up to 24 bits at 192 KHz are available with several rates in between.

The question at this juncture is not will the computer be used for high performance audio playback but how to get the best from this new music source. I have used the iMac in our main audio system to play back my CD library, download and play high definition music, DVD-A discs, DVD movies, stream radio from around the world, watch streamed television and even play back original live recordings at 24/96. The iMac in my system has over the past 3 years become at least as important as any other source of music, CD player or Turntable and is used daily. This primer will explain an approach that has proven to work well and to provide pointers on what to look for in a quality audio playback system based on a computer.

### Critical Issues for Quality Playback of Digital Audio

Most of the issues relating to quality digital audio playback are essentially the same for playback of traditional media such as the CD, SACD or DVD. There are, however, several important differences that will be discussed.

#### 1) Which Computer to Use?

I will primarily focus on the Mac as a preferred platform to store, access and play back quality audio. Some may find this limiting, although given the fact that a Mac Mini can be had for around \$600 it seems short sighted to not consider this route, given the advantages over the relative mine-field that awaits the PC/Windows user. I personally have had an iMac feeding my audio system and have had no issues related to operation. It is quiet, reliable, I know what to expect when I use it. Indeed it is as reliable an audio source as any CD player or turntable that I have used in the past 30+ years.

#### 2) Ripping your CDs

This is easily done- with the Mac systems the quality of the drives and integration of the software and hardware makes ripping music from your CDs into the computer a transparent and reliably efficient operation. Just set the Options within iTunes to insure error correction in ripping of the CDs and the system takes care of the rest. Even damaged CDs that may skip on a very good CD player will be corrected and ripped into the computers hard drive quickly. I would recommend using Apple Lossless to rip your

# bel canto

CDs as this does indeed result in a Bit Perfect playback and saves nearly 50% on space. However, given the ever decreasing cost of hard drive space you could save the data in a completely uncompressed format if you wish. With adequate playback hardware to address issues of jitter there is no audible difference in these storage formats. Just be sure to choose and USE a good method for backing up your music library-a RAID type hard drive setup or some other method should be used for backing your library up. Again-the latest Mac operating system has some very useful software to address backups.

## Digital Links for Audio Playback

There are several digital links available from the computer to your audio DAC:

In each case the critical issues to pay attention to are:

- 1) Bit Errors
  - a. Bit errors are discussed often but are really not a major concern in digital audio playback-uncorrected errors occur rarely and when they are not corrected they are accompanied by silence or clicks and pops-quite obvious, if they occur you will know it. Using the correction algorithms within iTunes when ripping my CDs I have found digital errors to be a non-issue, even with CDs that would not play back clean on my CD player.
- 2) Jitter
  - a. Jitter is a very critical issue that must be addressed with any audio DAC -no matter if the source is a computer, a CD/SACD player or a DVD player. Any digital link can easily impose levels of jitter that are easily heard in a high dynamic range playback system. At Bel Canto we address jitter right in the DAC with a robust jitter filter that attenuates the jitter components starting below 10 Hz, has jitter rejection of 80 dB by 100 Hz and increases even more at higher frequencies. With this filter we can insure jitter free audio playback from all digital sources.
- 3) Galvanic Isolation
  - a. Galvanic isolation is when the power and grounds between two components are isolated. This is critical for connecting to a computer as the power and ground system are not clean, first of all, and the ground loops that can occur when connecting a computer to an audio system can create noise levels that severely compromise the dynamic range potential of the system. We engineer galvanic isolation into all digital inputs on our high dynamic range DACs and deem this to be essential for quality playback.

# bel canto

There are several methods for connecting a computer to an audio system.

## **USB-Universal Serial Bus:**

USB is a reliable link to get audio data from the computer. It is being used more and more because it works reliably and simply. There are several methods for implementing a USB link. While some claim that superior jitter performance can be had using an Asynchronous method where the critical DAC clock is located on the DAC side of the link this method alone does not insure the best overall operation in the real world. Asynchronous design is a good approach for jitter but it does leave open other critical issues such as galvanic isolation as discussed above. The USB interface in our high dynamic range DAC products has galvanic isolation built in to insure optimum performance under all system conditions and our jitter filtration insures optimum jitter performance at the DAC clock for USB as well as all of the other digital inputs.

### **Issues related to the USB interface:**

- 1) Bandwidth limits using current USB 1.1 links limits operation to 24/96 audio streaming
- 2) No inherent galvanic isolation built in to USB links.
- 3) Maximum wire length of 14.8 feet sets a limit on where you can site your computer. I have used a USB 1.1 compatible optical extender from Opticis to get around this limitation. Bel canto is demonstrating a USB to SPDIF link that uses glass optical fiber for the SPDIF transmission that both provides galvanic isolation and allows running 100s of meters of small diameter, rugged optical cable.
- 4) Future USB links will use USB 2.0 technology. Indeed as of today Mac computers support USB 2.0 operation for multiple 24/192 digital streams!
- 5) Software compatibility: Bel Canto USB links are compatible with the native software drivers in both Mac and PC computers and are therefore transparent to use. They also can achieve bit perfect playback on both Mac and PC platforms.

## **Firewire:**

This link has been used for pro audio applications for many years and is well proven. It is typically more expensive than USB but can work well-it has not been as popular for home audio computer playback but certainly can perform well in this application. Galvanic isolation can be achieved within the Firewire standard but it must be designed into the link. There are no real limits to bandwidth for audio streaming with Firewire. Jitter filtration still needs to be designed into the DAC system and Firewire has similar limitation on maximum wire length as USB- about 15 feet.

# bel canto

## **SPDIF and TOSLINK:**

Mac computers and some PCs have built in SPDIF or TOSLINK interfaces. These function much like the same outputs on a CD player. The Mac TOSLINK can operate at up to 24/96 data rates and with our jitter filter can provide excellent performance-also TOSLINK cables can run to over 20 feet and provide galvanic isolation. Beware that with DACs that do not provide adequate jitter filtration there will be a noticeable reduction in dynamic range using TOSLINK. If you are using a desktop, tower PC or Mac computer you can also consider aftermarket professional SPDIF SPI bus cards-these are complex to use and require software installation and can be expensive, especially for the pro level products. However they can work very well and the pro level software can insure bit perfect playback.

## **Ethernet:**

Ethernet can provide very good performance but it is early days for this interface to stream audio-there is a new standard emerging called Ethernet AVB that promises to be an excellent option in the future. It will provide galvanic isolation, low jitter and long cable runs. So keep an eye out for this in the future.

## **Wireless:**

This is an exciting future option also. Today I have used the Apple Airport Express with a TOSLINK output to get excellent performance with our new jitter filtration method, note that without the jitter filtration of our new products the performance of the Airport Express is marginal. Also, Airport Express is limited to 16/44.1 data rates so it is not compatible with the new 24/88.2 high definition downloads.

The bottom line when connecting to the computer is that any of the above options can work well if used with an audio DAC that filters any incoming jitter. We have chosen to support USB for interfacing to the computer although our SPDIF, TOSLINK and AES inputs also support other options for streaming from the computer.

## **Bit Perfect Playback**

Perhaps the biggest potential quality trap related to computer playback is related to the fact that the processing power of the computer allows the original digital data to be modified, either through volume control, equalization or, sample rate conversion. The built in software in either the Windows or Mac operating systems is not designed for the highest quality performance. It is best to set up and use your computer so that the original data is not modified before being transmitted to the audio DAC. To insure the best playback steps need to be taken to insure that the computer is not modifying the original data. This can be done easily on the Mac/iTunes

# bel canto

platform, while the PC can achieve Bit Perfect playback it is rather more complex given the vagaries of Windows and the many different software options available on the PC platform.

This first step in bit perfect playback is to insure that the system volume control is at maximum. The Bel Canto USB Link disables the system volume and EQ controls when it connects to the computer's operating system so this eliminates this problem. Within iTunes or Windows Media make sure that the volume control is set to maximum, you do not want the computer changing volume level on the 16 bit words that make up the original CD data-this will absolutely degrade the sound. Let the Bel Canto DAC do this on the 24 bit word with correct dither, insuring a transparent volume control.

Finally make sure to disable any 'sound enhancement' settings within iTunes or any other playback software.

## Sample Rate Conversion

Both PC and Mac can play back the original sample rate of the digital file, however the system can alter the sample rate depending on the Midi setting on the Mac, and depending on numerous factors on different PC/Windows setups. In any case, when the computer performs sample rate conversion the software adds noise and distortion to the signal, causing a softening of the sound and loss of timbre accuracy and dynamic realism. Within iTunes on the Mac playback can be managed to insure that the built in software Sample Rate Converter does not turn you audio into mush. Just use the smart playlist application to group your library into same sample rate groups and use the MIDI controller software in the System settings to insure that the Mac is feeding the correct sample rate to the DAC. You may also want to monitor sample rate on the DAC to insure that you are getting what you expect. With the MIDI application on the Mac you can insure the correct sample rate playback. The operation is not as transparent on the PC and you will need to watch your DAC display more carefully.

## Conclusion

This primer on High Quality Computer Audio playback is meant to answer some questions surrounding this new source of music and to provide a blueprint for a system to access the exciting music that is emerging on the computer platform. While our experience encompasses both the PC and Mac platforms we have found that the most reliable quality playback is available on the Mac. This platform can easily be setup to operate day in and day out to provide a seamless source of music in your daily life. That is not to say that the PC can not serve in the same way but the daily ease of use and reliability of the Mac platform speaks to the music lover. In either case Bel Canto is positioned to help you to discover this new and powerful source of music and entertainment!

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