

Folks,

Some questions that came way in recent times and some more observations of my own make me think that someone needs to give a short rundown that is easy to understand.

I hope I'll be able to keep this straight forward.

First, the combination of "Asynchronous", "USB" and "192KHz" seems to be the latest "must have", something we may not entirely innocent in, having announced probably the first shipping high end units.

At the same time there seems to be considerable confusion what "192KHz capable asynchronous USB DAC" really means.

For example quite recently a high profile audio journalist* compared the Upsampler Chip in one DAC** to a true Asynchronous USB DAC***, implying their operation was similar or identical (which it emphatically is NOT).

In another case a Vendor**** advertised (most likely out of simple ignorance, rather than an ill will to deceive potential customers) a DAC as 192KHz Asynchronous USB DAC.

True, this DAC was "Asynchronous" by using an Asynchronous Sample Rate Converter (ASRC) which until very recently used to be called "Upsampler" and it was "192KHz" by virtue of using a 192KHz DAC Chip. So where is the problem you ask?

This DAC used a Burr Brown USB chip limited to 48KHz and 16Bit, so M\$ Window\$ or Mac O\$X will downgrade your 192KHz/24Bit File that you paid good money download, to 48KHz/16Bit (of course without telling you) and in both cases the downsampling is certainly not "studio" quality, so you would have been better off paying less for the CD-Grade copy.

The End Result is a little like ripping a CD to low grade 128K MP3 and then turning the result back to CDFiles and selling the result as the original CD.

I'm sure the vendor meant no ill.

He likely saw someone using "192KHz Asynchronous USB DAC" in advertising (Us?) and looked at his products feature sheet (the product was designed in china for him, maybe he does not even "get" digital?), noticed it said "USB" somewhere, read it said "Asynchronous something" somewhere else and found "192KHz/24Bit" written somewhere else and cheerfully concluded:

"Hey, I have one of these too, high time to tell the whole world that I do!"

(*/**/****/***** The identities of the individuals and products are generally known, but so as not seem to target anyone specifically for a mistake many may have made the identities are omitted)

To clear the confusion and to give anyone thinking about buying a High End USB Audio Product I'll try to clarify some of the terms...

192KHz/24Bit - It ain't necessarily so

(["It ain't necessarily so"](#) is a Song from Gershwin's Jazz Opera *Porgy & Bess* - sung by the character "Sporting life")

First, 192KHz/24Bit is easy to explain, as are the issues.

If taken strictly it implies a device that capable to accept a digital audio data stream at a sample rate of 192KHz and with 24 Bit word length and it should be able to decode the 24 Bit while offering a dynamic range significantly greater than CD. In theory 24 Bits allow 144dB dynamic range, so strictly speaking there is no such thing as a 24 Bit DAC as a 144dB dynamic range eludes so far even the most determined designers.

In reality many "24 Bit DAC's" mangle nowhere near this dynamic range, nor do most domestic situations allow anything like 144dB Peak levels, so this shortfall from the theory is mostly academic. Still, there are also "24 Bit" Dac Chips out there that do worse in terms of available dynamic than CD, obviously these are better avoided.

If in doubt it pays to find out the actual DAC Chip used and check the manufacturers Datasheet.

In order not to take pot shots at others, let's examine the DAC in the Cleo. It is a Burr Brown Device with 113dB Dynamic Range. This means when you play music with an 113dB peak level at your listening position the noise from the DAC will just cross the hearing threshold of the keenest eared listeners.

As the background noise in most listening rooms is higher than 20dB you would have to play music with 133dB peak levels to hear the limitations of the DAC. So in practical terms one may say that this DAC performs well enough, even though it falls far short of 24-Bit performance.

Our excuse for using it is simple. It sounds surprisingly good, better than quite a few better specified similar Chips from AD and BB. Just like ancient TDA1541 still sounds better with CD than better specified later DAC's.

Hence if you are buying a "24-Bit" DAC I'd suggest to expect better than 110dB Dynamic range for the actual DAC Chip, less would ring my alarm bells.

USB - Have you got your funky bus fare?

(["Double Dutch"](#) by Frankie Smith opens with the line: "Give me a HO if you've got your funky bus fare...")

Give me a "HO".

Okay, I'm good now.

USB is short for "Universal Serial Bus". It is simply a way of connecting a computer to a wide range of external devices, Flash memory Sticks, iPods, external hard-drives, printers and yes - USB DAC's and other USB Audio Devices.

It was meant to replace a lot of different computer peripheral connections systems, the names of which only curmudgeon's that grew up in Mainframe "Dino-Pit's" still remember and has largely succeeded.

An alternative to it is called Firewire by the marketing guys and IEEE1394 by engineers. It works largely similar to USB but is used much less frequently. It may be a little better in some ways than USB but the reasons are obscure and keep geeks debating all night over rounds of beer, too heavy for here.

In many ways we can lump USB and IEEE1394 into one basket where high end audio is concerned. In my experience IEEE1394 is a bit of PITA with a lot of chipset incompatibilities and can be a nightmare. If it works, it works fine but dislikes "hot-plugging". While a bit flaky and "plug & pray" in the early days I find the current USB systems mature enough that they work reliably pretty much all the time.

So, USB as such, absolutely no issue, no inferiority complex to firewire (no matter what man behind the curtain says). So, all clear.

USB Audio - The Guns of Brixton - Class Warfare writ large?

[\("The Guns of Brixton" is a song from the 1979 Album "London Calling" by London reggae punk rockers "The Clash", foreshadowing the race riots in Brixton and on the Broadwater Farm Estate in Tottenham in the mid 80's\)](#)

The first digital audio chips with an USB in/out appeared around the year 2K or so. The early 2K's saw a number of USB Audio devices, some of which were very bad (but are still used), while especially the Burr Brown PCM2704/2705/2706/2707 series allowed digital outputs that were at least as good if not better than really well implemented SPDIF at its best (and "like it's not even funny" better than badly implemented SPDIF).

It is at this point that some High End audio companies with some vision and foresight started to integrate and optimize these Chips into their DAC's (or in my case into CD-Players) and the two new product categories of "USB DAC" and "USB connected CD-Player" were born.

I think it is just to credit Wavelength's Gordon Rankin as the father of USB DAC's, while yours truly had a bit to do with the second category.

Now the first generation USB Audio Chips as well as the second generation Burr Brown PCM270X Chips and some quite recent chips (such as the chip in the two 96KHz USB to SPDIF converters reviewed in last month stereophile) all use the Drivers that M\$ build into Window\$ and that Apple put into O\$X.

These are known as "USB audio device class" with a 1.0 implied.

USB audio devices that work according to this specification (short called USB Audio Class 1.0 which is still not very short) can be connected directly to a PC or MAC and work almost immediately, no special drivers are needed, it is just plug and play.

There is a catch of course. You knew there would be one, right?

The vast majority of USB Audio Class 1.0 Devices are limited to 48KHz/16Bit though a very select few can handle 24 Bits and up to 96KHz sample rates in Class 1.0.

The Solution, you guessed it, is called "USB Audio Class 2.0". It can do 192KHz, even more if I read it right. It can do pretty much anything anyone would have wanted USB Audio to do ten years ago. I have been hearing about this for years now, every time it would be out really soon now. And I have evaluated a number of USB Audio 2.0 Chipsets and solutions. They generally all work okay.

Why have you not yet got the chance to buy a High End USB Class 2.0 Audio DAC (actually, there may be one or two, but even I have not heard about them)?

Because M\$ broke the USB Audio Class 2.0 Driver build in Window\$ XP Service Pack 2 (IIRC) and Apple did reputedly a job only slightly better implementing it in O\$X (means it works. sometimes. kinda.).

And either company has yet to properly fix their operating systems, quite a disgrace given how much time they had to do so. So USB Audio Class 2.0 is right now going up about as well as the proverbial led zeppelin.

Given that a few chip makers have sunk small fortunes into developing USB Audio Class 2.0 silicone - maybe they can put enough pressure on Apple and M\$ to get their fingers out sometime this century.

Until then, if you want 192KHz/24Bit to work properly across USB you have to write your own driver for Window\$ and O\$X. I have a great deal of respect for Gordon Rankin's effort in writing his own software for the BB USB Chip, the technology he now markets as "Streamlength Asynchronous USB", but writing a really working USB Audio Class 2.0 Driver for Windows is a lot harder, come on, even M\$ can't do it right ;-). No idea what it is like for people with Mac's, no picnic either suspect.

Big Companies like Creative/Emu pioneered writing your own drivers that avoid the USB Audio system entirely. Such drivers and the related devices use what is called "bulk mode", normally reserved for external hard drives to shift a lot of audio data quickly to the USB Audio DAC. There a local clock determines how the data is send to the DAC or SPDIF connector.

One further good thing for Windows users is, you normally get an ASIO interface which, with the right playback software neatly sidesteps all the hoops you normally have to jump through to get windows to produce a "bitperfect" (not re-/up-/down-sampled) datastream.

So, if your USB DAC claims to be 192KHz/24Bit but does not come with its own Driver CD, I would have major alarm bells going off. Of course, the state on this subject is quite fluent and it may change tomorrow, when both Apple & M\$ release service packs to fix their audio systems (yeah, right - and pigs fly).

This brings us to Asynchronous USB DAC's (finally I am sure you think, will he NEVER shut up?).

Asynchronous USB - Holding out for a hero??

[\("Holding out for a hero" is a Song by Bonnie Tyler's from the "Footloose" Movie Soundtrack](#). It was written by Jim Steinman who also wrote most of the songs for Meatloaf - I guess you'd call the genre dramatic bombast rock, just like the kind played by the fictional Band Disaster Area, you know, terrible songs with lyrics like girl being meets boy being under a full moon, which then for no apparent reason explodes. High Kitsch, so bad it's good. Boy the 80's where WEIRD!)

A crucial topic in digital audio is [Jitter](#), well not in the 80's (toldcha, they where weird), but nowadays.

Systems that work "Synchronous" imply that two clocks are being kept in good old-fashioned German goosestep, with one part of the system giving the marching beat to the other.

With both SPDIF and early USB Audio a system called a Phase Locked Loop (PLL) is employed and the source determined the actual clock for the conversion, with the DAC, SPDIF, USB or indeed Firewire playing slave to the CD-Transport or PC. Now the issue is that in order to be able to synchronize to the source, the slave must be able to change its speed.

Worse, it must do so quite quickly, in case the source changes its speed. So now first of all the DAC, in our case the clock slave will follow all the changes of the source clock and top of this it will add some of its own and then there is the quite inadequate SPDIF connection system in CD Transport/DAC combo's.

Just to keep things interesting, computers have something called "Software Induced Jitter". It is largely similar to the problem with CD-Transports where a scratched disk is read 100% without errors but still sounds worse than a clean unscratched disk. In the CD-Player the servos work harder to read scratched disks and thus modulate the clock that usually runs off the supply.

In a computer running CPU intensive tasks while playing music causes power supply modulations in a very similar way to scratched disks in CD-Transports. And our DAC's being slaved to this faithfully follow all these "jitters".

Is there a way to untie this Gordian knot? Sure. In a Transport/DAC combo we simply put the clock into the DAC and send it to the Transport, so the roles of slave and master are reversed.

Can we do the same for USB Audio?

Sure. We put a clock into the USB Audio Device together with a big memory buffer (it used to be called a "Digital Lens" in the old days).

Now our local clock in the USB audio device controls the audio stream and our software just needs to make sure to send enough data to the USB Audio Device to keep the buffer topped up.

The result? Computer clock and audio clock are completely divorced. Software induced jitter is cancelled. Best of all for a small high end audio company, the whole issues of clocks, clock jitter and all that are now well understood and we can do something about them.

That is why TRUE asynchronous USB Audio (be it using Class 1.0 Drivers, Class 2.0 Drivers or custom drivers) is so crucial.

If you want to know just what it takes to minimize jitter in synchronous PC Audio Systems head over to the Computer Audio asylum and have read of the CMP^2 meta thread.

Asynchronous USB Audio simply puts the problem back into the hands of the device designer. It does not as such mean that the implementation is competent or good, but it means at least that it can be.

It used to take me days to optimize a PC for Audio Replay via USB, now it is much, much simpler.

Now there is no way to easily check if a device is truly asynchronous. Many of the budget USB Audio units draw their power from the PC, so even if they are Async, they bring the whole problems from inside the PC with them. Others have bad clock implementations, still others have both.

I wish there was as simple a way to determine if a given USB Audio DAC is "well implemented Asynchronous", but there ain't. Here you rely on the vendor to be open and to tell you what they use and how.

For now, confirmed asynchronous USB Audio Devices I personally know are the following (alphabetical vendor order):

Ayre QB-9 DAC - based on the Wavelength Audio Streamlength System, limited to 96KHz

diyhifisupply Cleo & Morello based on heavily modified Musiland Digital Cores with new power supplies, clocks, tubes output stages etc., 192KHz/24Bit, ASIO, WASPI, WDM...

M2Tech Hiface and related devices - the original HiFace draws power from the computer, has not so great clock implementation and lacks ASIO but does 192KHz with its own driver

Musiland Monitor Series - very good software and digital hardware implementation, shame about the rest, 192KHz, ASIO, WASPI, WDM

Wavelength Audio Streamlength based DAC's, limited to 96KHz

Some others claim Async, but I have been unable to verify their claims at this time (other may be able to do so) so just because I do not know about it does not mean it is not Asynchronous. In fact I would encourage those who know for sure (and understand the facts) to add to the list of "verified asynchronous" devices.

Some "commodity" USB Pro Audio devices are likely asynchronous (confirmed for EMU 0404 USB for example) however their power supply and clock implementations usually make Musiland look good and hence cannot be recommended as playback devices.

Currently I am unaware of any asynchronous firewire DAC (Pro Audio or High End), Weiss uses the TC Audio DICE chip, which has an extremely clever way of reducing jitter (also works for the SPDIF inputs), but it is not asynchronous. Any device using Bridgeco Chipsets is at last count also not asynchronous.

All of the major chipmakers USB Class 2.0 Solution Chips I tested where not asynchronous when tested and indeed, several where not even bitperfect.

Conclusion - Jessie paint your picture?

([The Joshua Kadison Song "Jessie"](#) is supposedly about his breakup with "S*x in the City" Actress Jessica Sarah Parker. It is a song about promises not made good.)

For now, when you hear about the latest 192kHz Asynchronous USB DAC and you get "Fever" to buy one, take a cold shower first, then check the facts. That way you make sure you get what you think you will be getting.

I hope the above can help a little.