



Naim Server Sound Rip Technology

Steve Harris
Naim Audio
Southampton Road, Salisbury, SP1 2LN, England
steve.harris@naimaudio.com

1. Introduction

The Naim range of audio servers brings a new level of performance that before was reserved only to traditional high-end hifi products. Mixing high-powered computing with audiophile electronics is a complex problem to solve. This document describes the various issues in creating such a product and how Naim implemented custom solutions, to ensure we got the performance level that the products demand.

2. CD Ripping

The audio playback out of a hard disc server is dependent on the quality of the system that extracted the audio from the CD. Although CD ripping is not a new concept, to extract the audio so it is identical to the content of the CD is quite a challenge.

The key issues are:

2.1 Ensuring audio is extracted bit perfect, with ability to detect when a track is unreadable due to physical damage.

Naim uses a 'secure' sync locked ripping system that uses the specialist CD mechanisms error detection system, cache free hardware and a multi-read strategy. This ensures we get the audio data from CD to hard disc exactly the same as the original CD master made in the studio. Most PC based systems use 'burst mode' extraction, which may be quick (2-3mins per CD), but the quality of the resultant audio files can be less than desirable.

2.2 The lead in (the gap before the track) and lead out (the gap after the track) is captured for accurate 'gapless' playback of the ripped CD.

The lead-in and lead-out times are accurately measured and this gap is recorded onto the start and end of each audio file on the hard drive. The audio replay engine plays the files back the gaps (or no gaps) between each track identically to the original CD. Most servers do not capture this correctly and typically add a fixed gap between tracks, which on some recordings ruins the flow of the music on the album.

2.3 High compatibility with copy protected CD's, which are now commonplace in the market.

Naim uses custom firmware in the audio mechanism that allows the music server to copy the majority of copy protected and non-standard CD's. Streaming Media Players that require a PC to rip CD's will have varying compatibility issues dependent on the CD/DVD drive installed in the machine.

2.4 Exact capture of start and end of tracks.

Some PC CD/DVD ROM drives can miss the start and end of tracks by a few samples, due to the nature of the

audio CD format. The CD ripping engine and CD mechanism used in the Naim range of servers ensure the start and ends are captured perfectly, so gapless tracks on an album are played as the artist intended.

2.5 High compatibility of reading discs that are old and have accumulated small scratches and dirt.

Although we all treasure our music collection, the wear and tear of day to day use accumulates up over the years. The Naim ripping engine has a very high tolerance to scratched, dirty and out of specification discs. This ensures the minimum of fuss when ripping your CD collection to hard drive.

3. Audio Playback

During our prototyping phases of the Naim audio server, we purchased a variety of audiophile and pro soundcards, so we could measure what could be achieved using off the shelf technology. Our findings were not good. Due to the ways Windows audio subsystem works, the audio data going to the DAC's on the soundcard was a degraded version of the original audio on the hard drive. This came down to a component called Kmixer that is the heart of the Windows audio system and uses low resolution mathematics on the audio.

We also found that on higher resolution material, the drivers supplied with most sound cards were buggy and were truncating or sample rate converting the high definition audio to below CD quality.

To conquer these challenges Naim did the following:

3.1 Custom PCI 4 zone soundcard

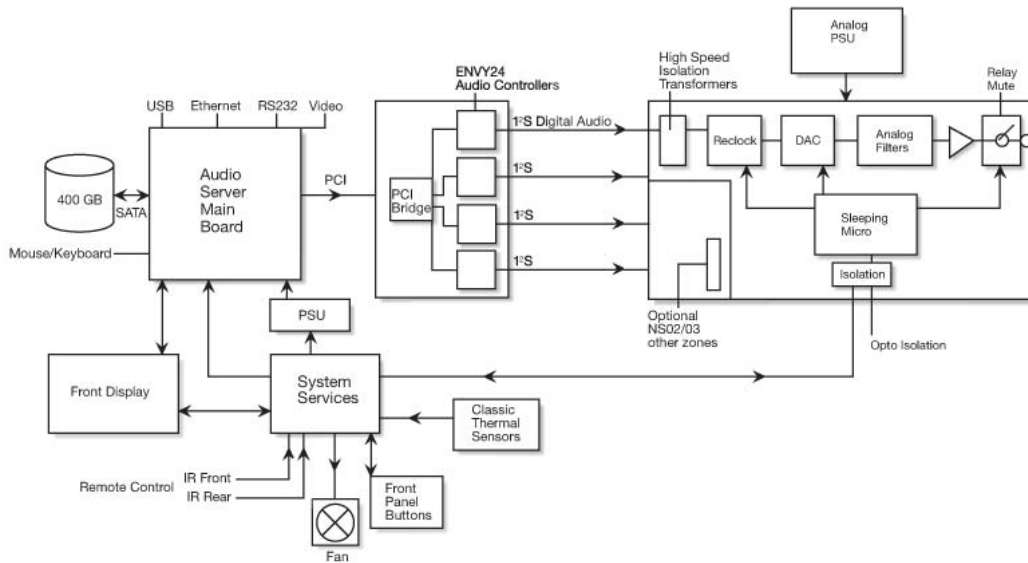
Naim designed and manufactured their own multi-layer PCI soundcard, with integrated PCI bridge, fitting up to four high quality PCI audio controllers in a compact profile.

3.2 Custom magnetically and optically isolated analog output board

Computers are electrically noisy appliances and mixing it with sensitive analogue audiophile electronics is a marriage made in hell.

Naim has conquered this by magnetically isolating the high speed digital audio data from the noisy computing domain, to the ultra clean audio domain. The audio domain runs on a linear multi-regulated supply that is completely isolated from the switch mode power supplied to run the computing domain.

The digital audio is reclocked on the audio board, so audio jitter is down to under 120ps.



3.3 Custom sound driver

To allow us to drive up to 4 stereo outputs of bit perfect audio, each playing different sample rates was requiring a custom audio driver.

Naim's driver ensures that the audio on the hard drive vs. the audio getting fed to the DAC is identical.

- Sample rates of 32, 44.1, 48, 64, 88.2 and 96kHz are supported at their native rate.
- Bit depths of 16bit, 24bit fixed + float format, 32bit fixed + float format.
- Other bit depths and sample rates are converted to 44.1kHz / 16bit for compatibility with external DAC's connected via S/PDIF.

The reclocking circuits in the analogue domain are controlled via an optically isolated 'sleeping' 8bit microcontroller. It receives instructions generated from the sound card driver when a different audio format is played. The microcontroller wakes up, reconfigures the audio electronics for optimal performance and then goes back to sleep again.

4. Conclusion

The average enthusiast can make a slim-line PC with a soundcard to make an audio server. To make one that sounds as good as Naim's traditional CD player range and works like a piece of hifi and not a PC, is a real technical challenge.

At Naim we're confident that we have conquered these goals. Have a listen to a Naim Server and you will discover that this is real hifi that plays music the way the original artist wanted it to sound.