Making the *dCS* Network Bridge

Part 1

In the first instalment of this four-part feature, Chris Hales, dCS Director of Product Development, gives his take on the new Network Box…

"This is for people who bought into pre Vivaldi, to give them access to network streaming of audio. Scarlatti, Paganini or even classic Elgar owners don't have access to this – unlike the new Rossini – and it's increasingly becoming the way that people are consuming music", explains Chris Hales. "This special product really came out of that need. In essence it's using the network hardware that we have in Rossini and Vivaldi, all the IP and know-how that we built up over the period that we have been developing that. It receives audio via UPnP, Apple Airplay, Spotify Connect, TIDAL and other sources and outputs bit perfect au-dio in a form that a legacy dCS DAC can use, and that's really what we are try-ing to achieve."

Chris says that it was a case of using the tried and tested dCS streaming plat-form and adapting it for this special box of tricks. "As far as the network hard-ware design is concerned, our platform is now well developed, although need-less to say some customisation was needed." As with the new Rossini, the net-work hardware itself is supplied by Stream Unlimited in Vienna. "The Rossini uses a Stream 800 board which is a very capable network solution, and the Network Box is using a variant of that – the Stream 820. This is essentially the same board, but with a slightly more powerful processor, plus it's wi-fi enabled. We really wanted to take advantage of this feature."

He says that dCS always recommends a wired connection for the best sound, "…if you possibly can. This is because you are guaranteed bandwidth which you are absolutely not with a wireless connection. But some users although they stream all their music files, may enjoy the added flexibility of wi-fi.

"The board itself is self contained and is not modified," explains Chris, "as de-livered by Stream Unlimited. But needless to say, it requires power supplies and is flexible in its own right. So one of the key things that we have done is to alter the clocking. So the Stream board plugs into a motherboard that has some typi-cal dCS circuitry on it that basically gives you all the benefits of our clocking system that you'd have in any other dCS product. The very high quality clock-ing gives low jitter, and of course it has our usual power supply arrangements. Traditionally we don't make too much fuss about dCS

power supplies because it's something that's just got to be done right, but perhaps that's dCS modesty – you need to do things well if you want things to work right. But the Network Box power supplies are typologically similar to what you would find on a dCS control board, with ultra low noise…"

In terms of connectivity, Chris says dCS, "is trying not to be too partisan", so it could be used with both dCS and a very wide range of other manufacturers' products too. "But the general idea is that if you have a dCS product, be it the very early Elgar or the most recent Scarlatti, you will be able to use this box to maximum effect. So we have processing options which will allow you to downsample to whatever the maximum sample rate your DAC can cope with, or not as you wish. The idea is to make the box as transparent as we possibly can where we can, and then to process minimally to suit your DAC where that's appropriate."

"The motherboard has a big Field Programmable Gate Array (FPGA) on there as you'd expect from a dCS product, which does all the processing and all the logic and so forth. It's not quite the monster that we have inside the Rossini but nevertheless we've got a lot of processing in there that can interface with the Stream 800 board and take that and send it out onto the digital output and so forth. So the processing platform is typically flexible and upgradable, as ever with dCS. All the software is done in-house as usual, from our algorithms to the control coding. What we have inside is by no means a generic Stream 820 by the way – there are lots of features which didn't exist before we commissioned them to build those in. We had a lot of dialogue with Stream Unlimited to shape the architecture of this board and to integrate these new features into our pack-age. I think many of the performance features wouldn't have been developed, if we weren't the lead customer on those…"

Overall, Chris says the new Network Box is an interesting niche product that will expand the horizons of both dCS fans and the wider audiophile public alike. "It's a product for the legacy market, but with very much the quality of that processing that you would expect from dCS."

In the second part of this four-part feature, Ray Wing – Head of Design at dCS – describes the thinking behind the new Network Box…

"I think we're almost seeing this as a service to our loyal customers, here's something to allow you to get up to date and benefit from the convenience of network streaming without having to splash out on the latest dCS DAC." Ray Wing, the man behind the mechanical design of every dCS product, is clear that the new Network Box is very much a niche device. "It's a special product – not part of our main range – which provides new functionality to existing customers."

"I guess we started on the project just before Christmas 2015, in terms of the actual hardware design. It's fair to say probably about this time last year we got the industrial design engineers involved, coming up with the concept of the packaging. That seems to be a fairly drawn out process throwing concepts about, discarding some, developing others and then discarding them, and think-ing about the concept of the problem, the backstory behind the product as well. But we didn't actually start thinking about hardware manufacture until just be-fore Christmas. Then we started work on the electronics about the same time, so I guess about nine months end to end really!"

Ray is responsible for the overall packaging of the product, and saw the new Network Box as a chance to trial run the making of future dCS machines. "For a long time now I have been wanting to investigate closures, which are a minimum amount apart so this was an ideal project where we could actually do some trials with our machining guys to see what was actual possible. The first time, we used one large piece of aluminium and machined it away, rather than screw-ing together different aluminium panels – to make the front, sides and rear of the case. It's an experimental thing really to see what is possible and it makes the whole thing much easier to assemble because there are only two initial parts. We were able to see the sort of issues that the machining guys came up against – the sort of problems we're likely to see if we decide to go with a one-piece box on our bigger units. After this, I think perhaps on our newer ranges it will be considered because this experiment has gone quite well!"

Indeed, it seems Ray has been rather beguiled by this new hewn-from-solid approach. "It keeps the amount of corner joints and all the things that have to be screwed together to an absolute minimum, so it's a more complete box. It has a top, two sides and a front, whereas they would normally be four pieces rather than just one piece, that's one of the attractions. As a result it can be stiffer, and because it's one piece, it doesn't need to be assembled so carefully as we have to on all our other products. The guys spend a lot of time making sure that all the cut and shut lines are true and correct; everything lines up, everything is in the right place. That affects the way we machine things as well, of course, but by doing it with one piece, many of these problems go away!"

He continues, "I suppose is what we're saying is there are a lot less fixings to start with, so there is a lot less to go wrong in that respect. We do have issues with current parts during the assembly process and this causes little teething problems in production which we shouldn't have to encounter. This is a way of keeping down those sort of problems. For example, if you break a screw off in a thread, essentially the part goes in the bin because you can't really get it out, that type of thing. We are continuously looking at ways of making the boxes better. With the new Network Box, the joins that you see are not actually joins, they're machined in to look like joins it's a way of disguising the fact that it's one piece when it actually looks like several pieces…"

"Another reason I have gone for the one-piece box is that it cuts down the handling of everything. You know – four parts being shipped from here to there, from the machinist to us, then from us to the anodiser, from the anodised to the silk screener, etc. If you've only got one part doing that route around the countryside, it is less likely to be damaged, dropped, lost or whatever. It also keeps our inventory down – just one part instead of four. There's not too much difference in terms of cost, but

it's certainly a more elegant solution. It keeps down the back office type stuff, that's where you start to see the benefit of it. The Network Box has been a golden opportunity to trial this…"

Part 3

In the third instalment of this four-part feature, Technical Director Andy McHarg describes his role in designing this exciting new dCS product.

"In our current range of products, one of the key things they offer is network streaming, including access to the brave new world of Spotify and TIDAL, etc.", explains Andy McHarg. "However, we're well aware that there are a lot of legacy dCS boxes out there, such as Elgars, Scarlattis, Paganinis, Puccinis and so on. And to those customers who have stuck with us over the years, we can now bring them something that will let them join in the modern way of doing things without having to buy a new DAC. That's because our classic DACs are still bloody good – going right back to Elgar."

"We can bring value here," Andy adds. "We started thinking about whether there's any way we can let customers with older – possibly second-hand – gear, access some of our stuff. One of the key things that we do is DSP, so then you start thinking you could have a box with a network input (which we already have the bits for) and an FPGA (Field Programmable Gate Array) to do all the housekeeping. That FGPA has quite a lot of grunt, so can we do something here? We started thinking if you have an older DAC and it only supports 96kHz then we can actually do a bit of clever repackaging and offer downsampling of say 384kHz to something your DAC can understand. We thought non-dCS customers might possibly buy this box too, because there's a lot of DSP inside – and our core skills are basically getting an FPGA and doing DSP with it. That's what made it worth us making this product."

So isn't this sort of project unusual for dCS, a company that normally comes up with highly expensive new products? McHarg agrees that, "yes, we don't do niche products as a rule, and we won't do something unless we can bring something extra to the table. What's the point in us making an expensive product that does nothing more than a basic box with cheap bits inside that the manufacturer bought off the shelf? That's our philosophy. There was some agonising during initial discussions about the Network Bridge because it does cost money to build, but we figured that we have always had this principle where you invest in dCS, you don't just buy it. You will buy into some kind of future-proofing, no matter how old it is. It may not commercially justify us doing anything, but our customers are probably watching the streaming of DSD content and thinking, 'I wish I could do that…'

The Network Bridge is not like any other such product, then. McHarg explains, "normal network boxes typically use a stock streaming board with a power supply and some socketry. But with ours we asked, 'what DSP do we need to do, and how about some re-packaging, and then do we need to lock to an external clock?' From that point, we were guided by how we answered those questions. How big an

FPGA do we need? How much memory do we need? How much upgradability is there for the future? So the design we came up with uses a modern FPGA with quite a lot of memory, plus a serious clocking solution. Once you've got that bare canvas you can design the PCB, then you take the specifications and you design the software and the firmware to it to make that PCB do something useful."

The platform chosen was the Stream Unlimited Stream 820, which is slightly different from the Stream 800 inside the Vivaldi because it has Wi-Fi functionality. It's also slightly faster, but the differences aren't huge. Wasn't Andy worried about the noise that's associated with wireless? "Every dCS product that we build, we take enormous care that nothing can get inside to spoil the sound. Wi-fi is different in that you have an antenna that is deliberately feeding things in from the outside world. So that bit is shielded – there is serious isolation built-in – we went to enormous trouble to reduce noise. And of course you can turn the Wi-Fi off should you so wish…"

Andy McHarg was responsible for the innards of Network Bridge, and is proud of what he's been able to do. "This absolutely was not built down to a price", he points out. "That's never been the way we work. With dCS you get performance parameters – how much stuff do we need, how to put it into practice and then finally how much is it going to cost? The result is a bespoke and unique product; even all the software is dCS coded. It's been a far more involved process than simply grabbing the streaming chip from a Vivaldi!"

Part 4 (Coming soon)