

On the true Meridian

When CD arrived in 1983, most British hi-fi companies either denounced it or ignored it. But for one, CD marked a new beginning. Meridian, founded in 1977 by electronics engineer Bob Stuart and industrial designer Allen Boothroyd, had already achieved some success with its slimline 100 series electronics, which stacked like elegant cigar boxes. But by the end of CD's first year, Meridian was marketing a player based on the Philips CD100, soon followed by built-from-the-ground-up high-performance models. In the late 1980s the company consolidated its position in digital audio with digital loudspeakers and still better CD players.

By then, Meridian had become part of the AGI group, which also controlled KEF; but in 1992, AGI went into receivership, leaving Meridian up for sale. This may have seemed a dark hour at the time, but it proved to be another major turning point. Bob Stuart was able to retain control and bring in new private investors. With new capital and new enthusiasm, the company could start realising its vision for the hi-fi of the future: intelligent, flexible, highly controllable systems which could embrace the new requirements of multi-room operation and video capability with ease, but with high-end audio standards. A Meridian system became as the antithesis of the usual untidy heap of ill-matched separates.

At the same time, Bob Stuart seemed to be taking on a wider role. In 1994 he became chairman of an industry pressure group called

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the Acoustic Renaissance For Audio (ARA), which pressed the DVD Forum to include a high-quality audio in the DVD-Video standard. This helped pave the way for the development of DVD-Audio; Bob Stuart was closely involved with this and with adoption of Meridian Lossless Packing, which enables the DVD-A disc to deliver six channels of 24-bit 96kHz sampled audio.

More recently, Bob was personally involved in the launch of DVD-Audio, when Warner's launch releases were demonstrated extensively on a Meridian 800/8000 system.

So for many people in the industry today, Bob Stuart really is 'Mr DVD-Audio', and he's been in the forefront of digital audio development for so long that it's rather hard to imagine him having actually played LPs on a turntable. So, rather facetiously, I started our interview by asking him if he'd ever actually owned one.

'I did buy a turntable. I bought one.' He laughs. 'My first source of hi-fi was a tape recorder that I'd designed and built myself, which was based on a Brenell tape deck. But I did buy a turntable: the Garrard 401 with the usual SME arm and Shure V15 cartridge. Later we had the obligatory Linn. But I was delighted to go forward into an era where the source was dependable, you didn't have to adjust it every ten minutes, and it didn't pop and click.'

Meridian's first CD player was the MCD?

'We had the MCD and the Pro MCD. This was right at the beginning, 1983; and it was fantastic, it was so much better than the other offerings at the time. It still stands up quite well if you drag one out and listen to it! So I was pleased with that. Of course, we'd worked with digital recording before this, from 1979 up to '83. The first consumer digital source was actually the Sony Betacam player

[with Sony F1 processor]. I'm not saying it was perfect. But the sound quality was fabulous when it was done right. And even then we knew that you could bring something into the digital domain and back again very transparently — as long as you dithered it properly and really looked after it.

Back then we discovered dither, and jitter and all the things that could make a digital systems good and bad. And let's face it, some of the early digital systems were horrendous, they deserved all the things that were said of them. And yes, there were turntables that would sound glorious, but they somehow weren't as practical. Most of our customers were very pleased with CD: it was music without all the fuss, and the worry. You didn't have to worry that the cleaning lady was going to break the needle!

'Speaking personally, the thing that I liked most about digital sound was the pitch stability. For the first time, a recording of a piano sounded like the piano was standing on the ground and not floating around. The sound was bolted down.'

The ARA looked forward to an audio format with higher resolution and more channels than CD. Was it really the multi-channel aspect that turned you on most? Or the higher resolution?

'Both. We put the ARA proposal forward in April '94 with a sense of urgency, because at that time the DVD format was crystallizing. In fact, we had to send the proposal to two groups: we had to send it to the MMCD group and to the [Toshiba-led] SD group. We could see that this carrier was coming, with higher data storage capacity but certain limitations that we knew about (peak data rate and so on). In fact at the time the MMCD disc had less storage capacity than DVD, because Philips were being more conservative about the optics. But yes, it was both.

We could see that there would be six or seven times the amount of data; that meant that we could get back into surround sound, which we'd had to abandon in the early 1980s.

'Back then we'd been doing quite a lot of work with Michael Gerzon, Geoffrey Barton and Peter Craven, with the then NRDC Ambisonic group, working on Ambisonic playback systems and other kinds of surround-sound systems. We kind of knew there was lot of promise in it but we also knew — and this was the reason I abandoned it — that it was perfectly clear that you couldn't deliver this from an LP. It couldn't be done. Not enough data, not enough resolution, not enough channel separation. Especially of course because in the coding systems of those days (like UHJ), all the difference signal — which on LP turns out to be mostly noise in the



theinterview

Bob Stuart is the UK's doyen of digital audio. Here he talks about DVD-Audio, MLP, 'format wars' and the future WORDS STEVE HARRIS

groove (vertical modulation) — is clearly focused behind you, and separated out. So it's impossible to deliver a sensible experience and we thought, "we'll leave this alone for now".

'But then it was perfectly clear to me that with access to six times the data, we could go for higher resolution, which we knew was needed. First, we needed higher sampling rates. Everyone was fairly clear that 44.1kHz was too low. It turns out to be too low because according to sampling theory, 44.1kHz will give you 20kHz audio, but it gives you a very narrow guard band. So you have got very steep filters, and steep filters are hard to design. It's not actually a theoretical problem, it's a practical problem.

In addition we could go for higher resolution. If you have a chain from microphone to speaker which overall achieves 20-bit, then that is good enough if everything is done right. And the reason 24-bit is needed is simply that there is room to make some mistakes. 24-bit gives you enough headroom, so that the reproduction chain shouldn't affect the recording. So the ARA was really about making a proposal on how to use this space and this data structure which was already seen to exist on the then proposed video discs. If you remember, the ARA proposal was for 96/24 surround and two-channel, with lossless compression, still picture, actually all the things that turned out to be in the final DVD-Audio spec.

'The ARA was founded with a mission to increase awareness of surround sound. But at that time there was very little interest in surround sound outside some niche enthusiast groups. Particularly, Japanese companies were interested in surround sound because they still hadn't quite recovered the "loss of face" from the quadraphonic experience of the late 70s. But very slowly, everyone was turned round. The DVD-Video spec, when it eventually came out, was quite rich in surround sound. In fact, in some ways, it was a better spec than DVD-Audio. It allows eight channels at 48kHz/16-bit and specifies a whole range of speaker positions. But, as with the four-channel option in CD (which was never used), nobody ever made a player to do it, nobody ever made a recording... so that part of the DVD-Video spec languished. One of the specs that was picked up was the 96kHz/24-bit two-channel, because players could play it easily. That led to a small but interesting collection of discs.'

When did the saga that led to MLP actually begin? The ARA envisaged lossless compression, but you didn't have a system then.

'The ARA proposal was unusual because it wasn't made with a commercial pretext. If you look at the people — Malcolm Hawksford (University of Essex), David Meares (BBC), Tony

Bob Stuart was an innovator from the start: some earlier Meridian products (below) were the MCD player; modular component system; the first digital speaker; and 200 series two-box CD player



Griffiths — who was at Decca at the time, myself: that was the core committee, and in the background you had Chris Travis, Peter Craven, and Michael Gerzon who understood a huge amount about how to code for surround sound, which was very helpful. But the objective of the ARA proposal was simply to raise awareness.

‘From my point of view, chairing the thing, I wanted to express what we could so clearly see as the right way to go, as a gift almost to the industry. After all, this was the industry that had given us a place, and a subject we all loved. So we said “this is how we think it should be,” and handed it over, naïvely expecting something to happen.

As you know, we circulated it very widely. What followed was a resounding silence! But having published it, I went to Tokyo in October ’94, and we did demonstrations to the ARA Japan, which interestingly was chaired by a man called Bike Suzuki, who later became the chairman of WG4. We set up demonstrations and introduced people to the idea of surround and talked people through the proposal for the disc. Just running it up a flagpole really.

‘At that time, I don’t think anyone thought much about it. But from then, — I’m not going to claim causality, things actually began to happen. The Japanese formed a committee called the ADA (the conference for Advanced Digital Audio) and invited me to be on it. (It was hard back then to be the only non-Japanese on a committee.) ADA considered what the next disc should be. And the report was fascinating. It really just talked about: should we do surround or not, and what coding system should we use? PCM (96kHz or 192kHz); what you might call a MASH system — which was 8-bit, 8-times oversampling and is actually a very interesting coding system; and single-bit coding. And in a rather Japanese way, of course, it came to the conclusion that all coding systems were great, but the best one was PCM!

‘Soon after that, we saw the beginning of WG4. The DVD Forum said, “right, we need an audio disc”. I think that was finally motivated by Warner. Even up to that point there was no discussion of lossless compression. And at the time that we’d written the ARA proposal, we’d no intention of working on one. My attitude was, if we need lossless compression, someone, probably a large company will sort it out. But to make the ARA proposal, we’d had to do some studies. Michael Gerzon and Peter Craven came up with some inventions which we jointly patented. Michael had come up with a couple of very clever things to make a compressor using lossless processing, but there was never any real reason at that time to pursue it.

‘The DVD Forum started on its slow progress towards DVD-Audio based on mixed and scalable PCM. Although we stood on the sidelines, and said, “you shouldn’t be doing this, you should be considering lossless compression, don’t forget advanced pre-emphasis (another thing we all felt quite strongly about, because it’s so efficient), nothing much happened. I guess our impression was that the hardware companies didn’t want complexity. But about that time, and this is now four years ago, I suddenly realised that they were definitely going to need lossless compression. So we decided to begin developing it, speculatively. It was kind of a long shot, that we could a) get it working well and b) get it into the format. But that’s how it began.

‘I suppose there were two defining moments in there. One was my realising that lossless compression was going to be needed. And that

was almost exactly the same day that Michael died. Which was very sad, because I’d just said to Peter, “It’s time to go with this, I think we should put it together just to prove that it’s possible.”

‘So Meridian started to develop MLP, pretty well targeted at the evolving DVD-Audio application, but usable for any audio. We’d known, even back in the ARA, what the key criteria were: the amount of compression needed, the way it would work on multi-channel, and the fact that the peak data rate was going to be a problem. A lossless compression system cannot compress everything; some sounds cannot be compressed. So you have to legislate for that. If you make a .zip file, it gets smaller but it’s perfect. When you unzip it, all the data comes back. But it doesn’t tell you anything about the rate of data going through. Whereas with a system to be delivered on a disc, you also had to compress the peak data rate so that not only was the file smaller, but the speed to deliver it was also reduced.

‘Very soon after we had a specification and something working, I started to talk to Dolby. I realised that if this was going to be big, there was no way we (Meridian) could handle it, and it was right up their alley. And we talked to Dolby on and off for two years. We got our compression system working very efficiently, extremely well in fact. But up until that moment, every time we had a board meeting at Meridian, I’d have to say “We’ve done this, but I haven’t got a clue if we’ll be able to sell it.” We had a kind of breakthrough, when I was invited to go and talk to the ISC (International Steering Committee of the music industry) at a technical meeting of the IFPI, RIAA and RIAJ members. Also at that time, I had to go to Japan where we held an ARA meeting, and we invited WG4 members: I demonstrated lossless compression and some pre-emphasis schemes. And that also resulted in a resounding silence.

‘The thing that made the difference was the music industry deciding that when there was surround, it had to be 96kHz/24-bit, six-channel. Because at that point, you may remember, the DVD-Audio specification was 192kHz stereo; 96kHz was possible but you had to have 48kHz in the back — the mixed sample rate idea. Or 24-bit in the front, 16-bit at the back; both ways of saving data. So the music industry said “No, it’s got to be 96kHz everywhere — it’s important”. So WG4 decided to select lossless coding. And at that moment, a lot of things happened. Dolby decided that they would definitely represent our system if we could get it into the format, and they would give us assistance and advice to do that. We held a press conference at the Stereophile show in San Francisco; we announced that it was going to be used, that there was going to be a lossless system, and described ours. And that was when MLP was announced.

‘And that began a period of most intensive activity. Looking back, it was tremendous fun at the time... but it was quite distracting. If we’d known right back at the beginning what was going to be involved, I might never have considered it! However, as it turned out, it was brilliant. When WG4 said they wanted a lossless compression system, there was a very short timescale to select one. In the event, four companies made a proposal. But between the time of announcing that there was to be a proposal and the deadline was a matter of weeks. So some companies were scrambling to invent a lossless system. One had been thinking about it for about three months, because they’d seen the way the wind was blowing. But we had a working system. I suppose we kind of annoyed people a little bit, by showing up at the first meeting and saying “Here’s one, would



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you like to hear it?”. One day we might write a book about that! But it was a very intensive period, and the competition was absolutely fierce. And yes, I had to go to Japan a lot. That summer, I ended up having to go to a meeting in Tokyo almost every Friday for eight weeks. The great thing about the selection process for lossless coding was that everybody agreed up front that we didn’t need a listening test. All we had to do was prove that the data was the same after and before, and not go through complex testing. If we’d needed listening tests, we’d still not be there now!’

I guess there’s a certain similarity between Meridian and Dolby as companies: both independent, privately-owned, able to do things you want to do...

‘That’s true. We do answer to ourselves. In fact that is one of things that helps us a lot in our work with the DVD Forum, because we could go to meetings and whenever it came to a difficult issue, the other people in the room had to go back and — in the case of the large companies — it would take a week to get the answer back. Whereas Colin Aldridge and I could sit there, look at each other and make a policy decision on the spot.

‘So we had the committees, and eventually... we called it lossless summer (this was 1998). Because the call for proposals was announced in April, and we went through the trials, which were very difficult to achieve. For example, we had our system working on NT computers but we were told that all the testing was going to be done on the Sun operating system. We had 10 days to port MLP to the Sun system, and test it!

‘MLP was selected because it was the only system that effectively dealt with the things that the ARA proposal had pointed out. And of course, it had some very interesting additional features, things that fascinated the music industry; like the ability to carry additional data, metadata, and to have the embedded and dynamic downmix [to two channels] that could be delivered losslessly.

‘And then [November ‘99] the Norwegian broke the protection system. And that meant that the product couldn’t be released, because there needed to be a new encryption system. And that took another year.’

Do you agree with the idea that by the end of this year DVD-Audio will be effectively an add-on part of most DVD-Video players?

‘Yes. I think that by the time the players are in the third generation, which I see as being by next spring, the key silicon will be in one chip. So it’s really a matter of what peripherals they’re going to add. You’ll see both two-channel DVD-Video players that play back DVD-Audio, and ones which are multi-channel. Obviously the multi-channel player will cost a bit more to make. It’s got more sockets and more DACs. And maybe the following year it will then have a DVI or Firewire output. But I believe that above \$200, nearly all players will be DVD-Audio players as well as DVD-Video players, as well as CD players.’

Have you ever done any demonstrations of DVD-Audio using two-channel material?

‘Very rarely. It’s a fairly niche thing. I think, basically if there’s a two-channel disc on DVD-Audio, it’s because somebody had a nice recording and wanted to issue it. They might better off issuing it on DVD-Video, apart from the obvious copy protection complexities which may arise. Because this is the introduction, we’ve tried to introduce the capabilities of the format.

Do you think there’s a danger people who buy a DVD-A disc and just play it on their 5.1 system will just wonder what all the fuss was about, because they’re not actually experiencing high resolution?

‘That’s hard to say. I think that in general, if you have a system which is capable of surround playback, at whatever quality level (from the most miserable to a Meridian!), you already know what CD sounds like played back on that system. And in general, people



John Major officially opened Meridian's new factory in 1996

will be excited by the surround-sound capability. In fact, it may well be, that below a certain quality level, surround is more important than resolution. What I’m talking about is playing back Dolby Digital on a video player. If you take the same system and put in a player which is DVD-Audio capable (so now we get PCM), it doesn’t necessarily matter what the quality level is, you’ll hear the improvement from the DVD-A zone compared to the CD.

‘We always lived, as the hi-fi industry, right on the edge. The fact that CDs sold by the zillion enabled the catalogue to be rich, and the format was good enough that at the high end you could make players and speaker systems that got a lot more out of it. But that wasn’t what was funding it from the music industry point of view. Mass acceptance was needed in a new music format, otherwise there’d have been no hope.

‘Now, the fact that DVD-Video has been meteorically successful — it’s increased twice as fast as any other format — is a strong indi-

‘Every board meeting I’d say, we’ve done this, but I haven’t a clue if we’ll be able to sell it!’

cator. People have adopted it, they understand it, so now there are 35 million players that you can immediately put the new disc into.’

So... what about SACD? It’s pretty obvious that SACD started as a two-channel extension of CD and then rather quickly had to have multi-channel bolted on to it. Do you think SACD will survive only a sort of add-on go-faster thing for Sony players and discs, or do you think it will continue with a life of its own, with many proponents?

‘I don’t know. I say “Betamax!” at this point, if it wasn’t for the fact that the discs are the same size...’

There’s no reason why you can’t provide people with a card to play SACD on the same player as DVD-Audio?

‘Well, there is, and that is an issue. Everybody thinks it’s all very simple and that you can make a super universal player that could perfectly play back DVD-Audio and Super Audio CD. But the fact is that these players are so completely fundamentally different inside... we think Meridian is good — really good — at making optical disc players, but we consider it to be a non-trivial problem to make a player that will be great at both.

‘The real question is, does it add anything? I think we’re coming to the time when that might be put the test, finally. I mentioned earlier that way back at the ADA in 1995, the prospect of single-bit recording came up and was rejected uniformly by the ADA, and it was rejected again by WG4.

‘I gave a paper to the AES years ago which showed that compared with the optimal coding system, 1-bit/64-times oversampling is only

25% efficient. Just as a way of delivering audio, that seems to be silly. The idea that 1-bit is somehow "pure", is nonsense, because it's pure in sense of 'pure analogue', which to me is an oxymoron. The 1-bit stream exhibits many analogue-like properties; the fact that it degrades, that is imperfectly non-linear, that it adds noise; the fact that when you work on it, there is a loss of information. This isn't the case with PCM. In the PCM domain, the audio is robust, you can work with it transparently, you can get the same data back.

'It seems to me that there is mounting evidence that 1-bit has a sonic character. We're now fairly convinced that the presence of high-frequency noise adds a sound quality that some people find attractive if you're not realising what's going on. It's raising the perception of certain details, it may even be euphonic, but it is not correct. It's covering up all the high-frequency information that is there, and effectively raising the not-so-high information. So I believe there is a sonic signature, which makes it inappropriate for archiving; and it's inappropriate for delivery, because it's inefficient.

'So yes, we have a prejudice. But it's not because of MLP; we were saying this before we developed MLP. And one of the reasons that I've stayed behind DVD-Audio is a true belief that it's a better coding system. Now, if DVD-A had had 1-bit on it as an option, we wouldn't have minded at all, because that would be a choice, people could use it or not. That would have been a good outcome. But it failed at the Forum and now we have this awkward bifurcation. However, if you set all that aside and recognise that both are high-resolution audio formats, they are both better than CD, beyond question.

'The so-called hybrid (high-density plus CD) disc is a complete red herring: it makes the disc more expensive. DVD-Audio can be made with a Red Book [CD] layer, but so far the Forum decided not to.

'Then the third leg of the stool, if you like; when the ISC deliberated and said, "here are the 13 requirements for a new music carrier", on that list is "effective copy protection". A format that doesn't have the five major music companies behind it is sunk. And actually — while we may fuss about the sound, or whether it uses an appropriate coding — what's going to happen is that in the power base of content, where it really matters. People will say, "Is there adequate copy protection? I'll support this one. Is there a market for discs? I'll support this one, can it work in the PC space? I'll support this one." And I think in the case of DVD-Audio the answer is "yes" to all three. With the other disc the model is different and the market prospect is different. So economic forces will matter much more than the absolute quality.'

There's a perception among audiophiles that copy protection will compromise DVD-Audio. What's your comment on that?

'The audiophile can want what he wants, but if the music owner doesn't want to release it, then it's all over. The CD catalogue is so rich and so huge: if you want to get close to that with high-resolution, you have to look after the real interests of the artists, and the real interests of the music companies. To do that, there has to be effective copy protection.

'Now, they've said that they want the disc not copyable on a computer, and DVD-Audio uses an encryption system that succeeds in this. And I believe that SACD's visible watermark does at least mean at the moment that it can't be copied on a computer. But wanting to tag the music with a watermark is a very, very emotional issue. Yes, for an audio person it feels outrageous, what we would call distortion... until you get it in perspective.

'The watermark is only added if the artists and producers are happy. It's only one of 20 or 30 operations which are carried out on the audio: the audiophile idea that you have a pair of microphones, you know, and a straight wire to your loudspeakers, is so far from the truth as to be a joke. We all know there are many recordings where

the artists weren't all in the same room at the same time, or some process has been carried out on it, or it's been remixed: the watermark's just one aspect. But I think if the artists are prepared to say "That's fine, we can't hear the difference; but we won't release our content without it," we have to respect that. Not all artists want to do it, not all content providers want to do it, it's not always economical to do it. It's obviously important if you've got really high-value stuff like Madonna or Metallica.

'I think eventually, technology will evolve for the identification of content, but in the meantime the watermark will be used. But it's not a DVD-Audio thing; it's only that DVD-Audio players are the first thing that will detect it. The fact is that if a company's going to watermark its release, it will be on the CD, it'll be on the cassette, it'll be on the download, it'll be on the SACD, it'll be on the DVD-Audio disc. It's a level playing field. My perspective is that if we want high resolution formats, which in the case of DVD-Audio means putting the master tape in people's hands (we've had the chance of playing back the disc against the original hard disk master recording, and you cannot hear the difference), then if they want to tag it, they should be allowed to tag it. It's their business, and it's not our business to stop them doing it. If you're going to say "It's no good because I know it's got a watermark in it," you could equally well say "It's no good because it's got EQ in it," or it's been requantised, or they changed the level by 1.5dB from the microphone to here, because all those things are about the same sort of consequence.'

So you couldn't hear the difference with the watermark in it?

'I have not yet had the opportunity of detecting a watermark. I've heard lots of recordings with and without and I'm quite happy with

'The audiophile can want what he wants, but if the music owner doesn't want to release it...'

what I've heard. I think actually it's something not to worry about. You put a disc on, play it back, ask yourself "Do I like this?" Yes, I really like it. And most things I've really liked I know are watermarked. But if you started to worry about that you would legitimately have to worry about everything else that was done: did they use an echo processor, did they use de-noise?

'What else can we do? The complexity of this is that the watermark has been broken before it's been launched; people claim they can remove it. And there are technologies, I understand, which can do what we would like to be able to do, which is to identify the performance after the first three notes. You could say, ah yes, that's the Pathétique, and it's Ashkenazy playing, it's the 1963 recording.'

Then the watermark would no longer be necessary? You could do the identification without having to interfere with the content.

'Yes. Because one reason the watermark is needed is to be able to prove in a court of law what the content is. But the other reason, and this is really important, and leads even the audiophile companies to want to watermark, is that every time the music is played on the radio it is logged and the composer gets his royalty.

'We have to recognise the rights of the copyright owner. And also we should remember that before CD came along, the music industry was in the doldrums, sales were down, quality was bad: what we don't want to see is upcoming technology meaning that it's not possible to release high quality material because of the fear of wide-range piracy. So if that's the price of admission, yes, that's OK. Because they're going to do it for CD anyway!

'I sound like a lawyer or a policeman, but I'm not. I'm a pragmatist. If copy protection gives us a guaranteed, rich supply of lots of discs, with 99% of what we could have had in an ideal world, then we'll go for that!

'Because it's many times better than what we had before.' 