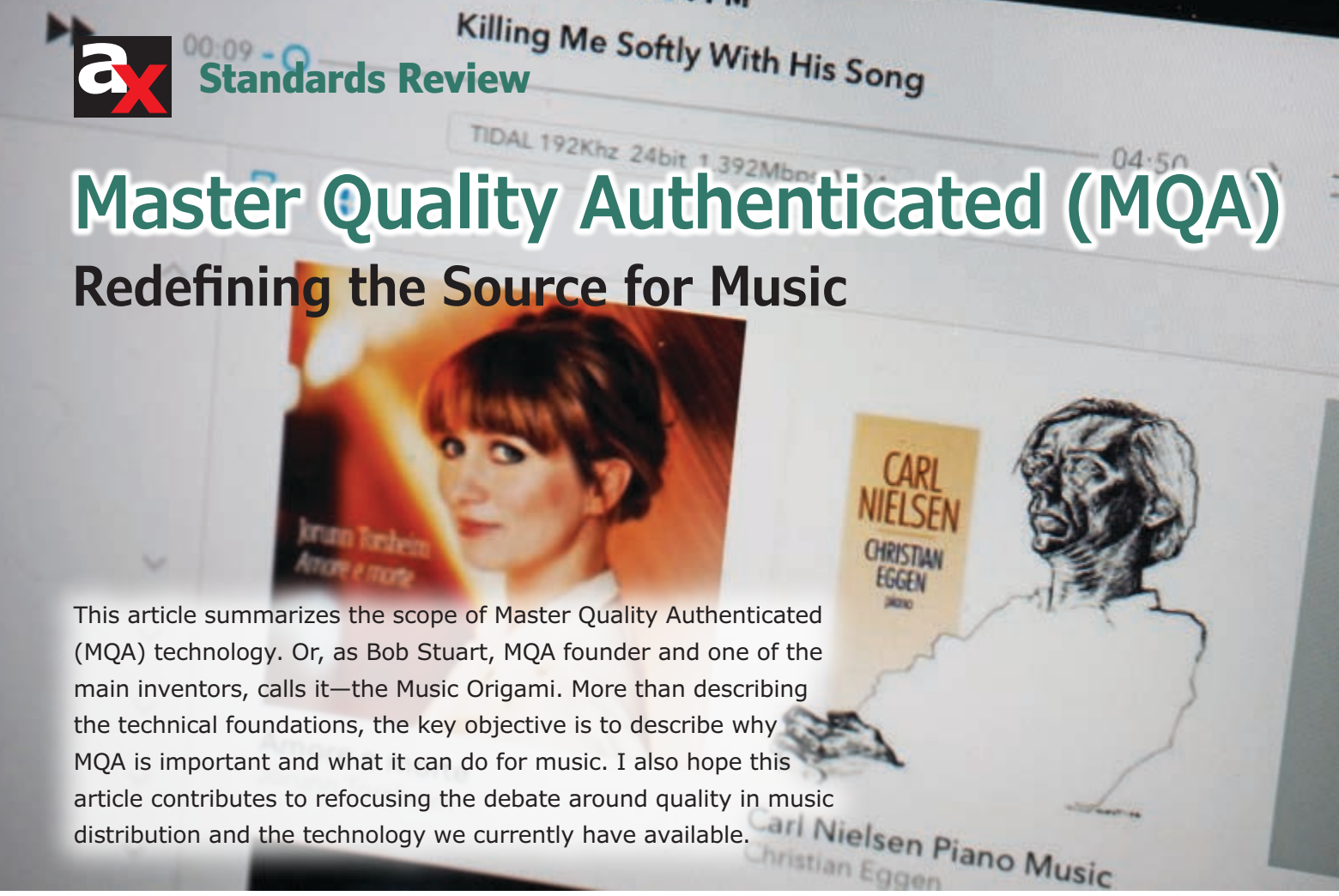
# Master Quality Authenticated (MQA)

## Redefining the Source for Music




This article summarizes the scope of Master Quality Authenticated (MQA) technology. Or, as Bob Stuart, MQA founder and one of the main inventors, calls it—the Music Origami. More than describing the technical foundations, the key objective is to describe why MQA is important and what it can do for music. I also hope this article contributes to refocusing the debate around quality in music distribution and the technology we currently have available.

By
**João Martins**
(Editor-in-Chief)

MQA is a revolutionary end-to-end technology that captures and delivers master quality audio in a file that's small enough to stream or download. And because its source is fully authenticated (by the use of embedded metadata), listeners can be sure they are hearing exactly what the artist recorded and approved in the studio—the same digital music source.

Using pioneering scientific research into how people hear, the MQA team has created a patented technology that captures an original studio performance and delivers a digital file that is backward compatible, so it will play on any existing digital device and deliver the full experience of the master source when decoded by MQA-capable equipment.

Centered on Bob Stuart's research and leveraging significant recent improvements in digital audio, MQA also captures all crucial timing information of the original performance and recorded master by encoding a new digital file to avoid all the degradation and loss of information resulting from previous digital sampling processes—as they existed until now on standard delivery formats.

To do that, the MQA encoder analyzes and recognizes the effects of the equipment and processing used in the original recording method to create a master, including its bit depth as according to the dynamic range. That is part of a patented process, the details of which have not yet been fully disclosed.

MQA is a process confirmed over years of development and in listening tests. It uses a new sampling method that, in Stuart's own words "can resolve the finest time divisions we can hear." It is a new encapsulation procedure that is "informed by the latest neuroscience and psychoacoustic research that shows how we identify and locate sounds, and that timing details of a few microseconds are important. This new technique combines this extreme level of time accuracy with authentic dynamic range."

### The Theory

This is the result of several years of research by Bob Stuart and Peter Craven, into a new hierarchical method and set of specifications for recording, archiving, archive recovery, and efficient distribution

of high quality audio—presented in a paper at the 137th Audio Engineering Society (AES) Convention (Los Angeles, CA), in 2014. This presentation explores the benefits and challenges of digital audio in terms of higher bit depth and higher sampling frequencies, and the resulting perception of quality in the analog domain, in particular "in terms of temporal fine structure and lack of modulation noise." It also questions the existing sample rate or bit depth techniques used to generate high-resolution audio (HRA) files that resulted in "excessive increases in data rate with resulting lack of convenience for the end user."

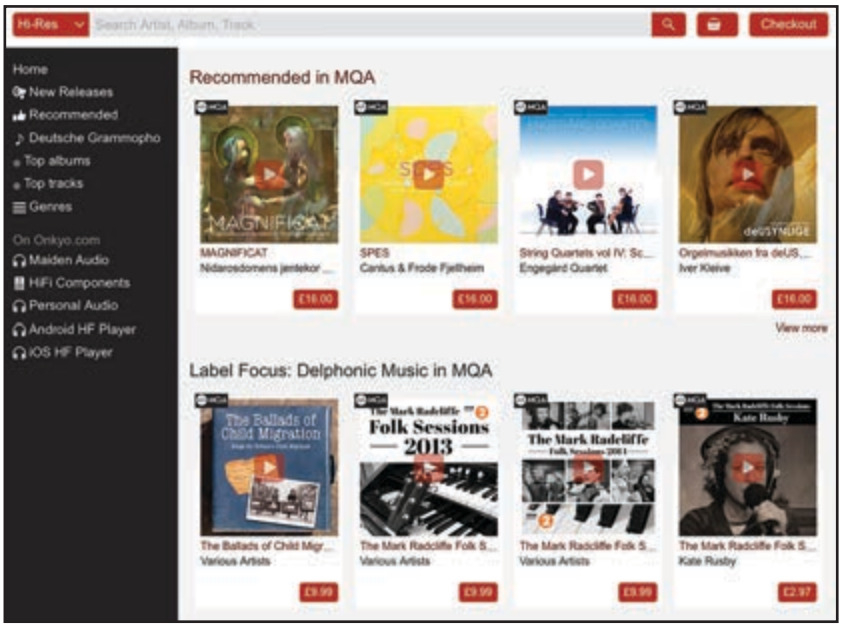
As stated in the AES paper, "A postulate in MQA is that by combining the statistics of musical signals with modern methods in sampling theory and insights from human neuroscience, we can more effectively convert the analog music to digital and back to analog." Not by creating a new codec, but instead an end-to-end process compatible with existing formats.

That would lead us to an extensive and detailed discussion of the Shannon-Nyquist sampling theorem, time resolution, and how the human hearing perceives it, the effects of time smearing in A/D and D/A conversion, the effect of the filters applied in the process, and so forth. All this is extensively discussed in existing literature, including, many of the presentations by MQA inventors.

The important thing is that the result of the aforementioned study is applied in the MQA encoding process to generate better quality audio results that have been widely praised by everyone who has heard it. As the AES paper states in the final remarks: "This approach to re-coding results in superior sound and significantly lower data-rate when compared to unstructured encoding and playback, and has been enthusiastically supported in listening trials with a number of recording and mastering engineers, artists and producers."

This is the first and probably the most important foundation of the MQA technology. But MQA has another important benefit, which is to deliver the results of this better-quality process "in a file that's small enough to stream or download."

In the already extensive literature published on the technology (see References), MQA considers three key areas of the recording. The very high-frequency content (C), which is mainly noise—albeit important noise—is "encapsulated" and hidden away below the noise floor. The high-frequency information (B) is losslessly compressed and hidden beneath the noise floor. The regular CD-quality component (A) is stored normally—but underneath all the musical information, below the noise floor, B and C are hidden. So the finest detail of a recording is captured in its entirety, and ingeniously "folded" into a package that behaves like a normal CD/DVD-quality lossless file. This is what Stuart calls the "music origami" approach.

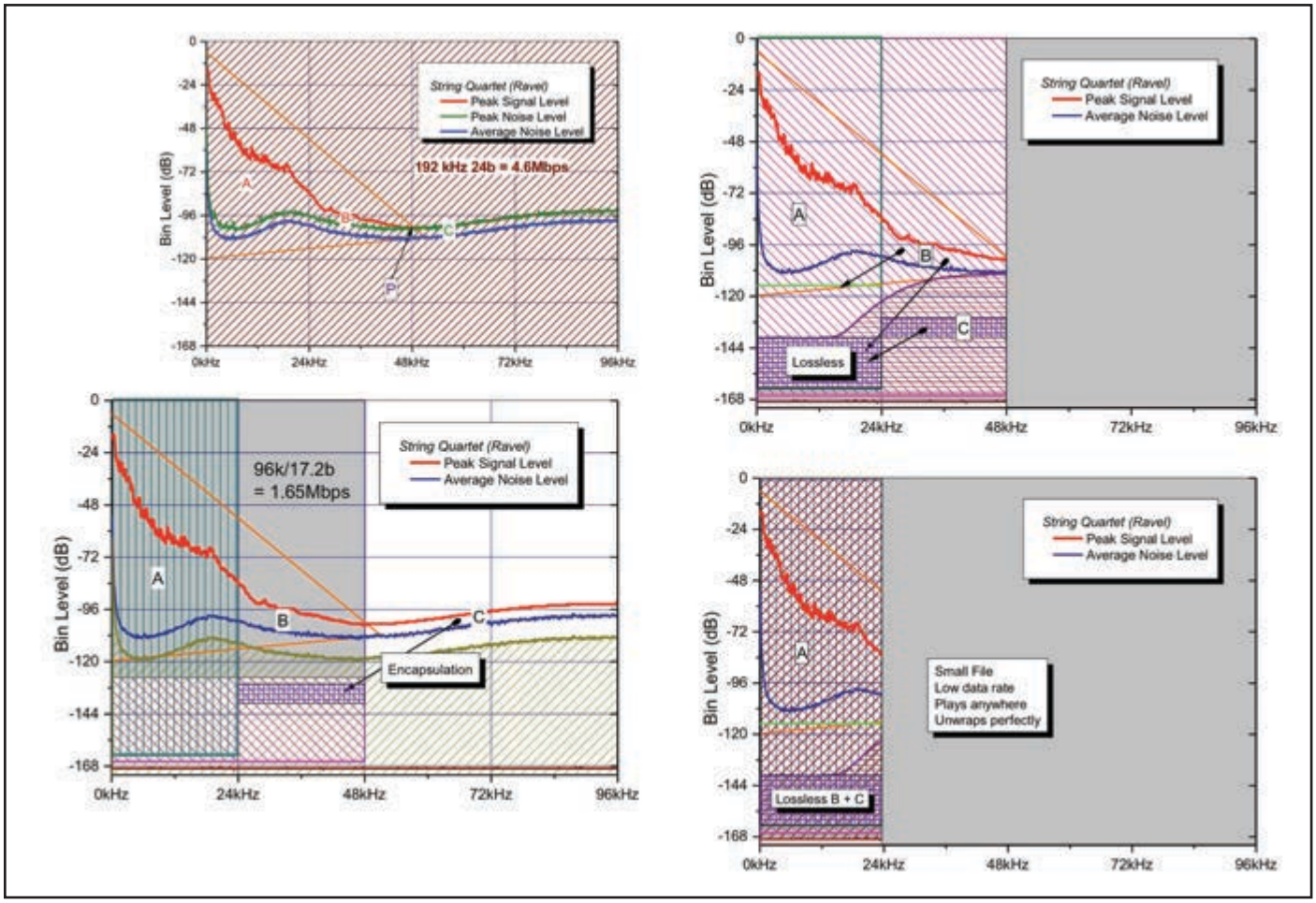



The MQA promise: One master source for music with the convenience of downloads and streaming services.

The goal is to recover existing information in the original recording—by doing a completely new digital encoding process from an analog master or by re-coding from any existing digital master (even a standard PCM 16-bit/44.1 kHz), and still generate a manageable file.

As Stuart explains, "higher sample rates can make improvements to the sound, but most of the "encoding space" created goes unused. It's like putting the music into a bigger box, most of which


Bob Stuart explains the MQA philosophy at the 2015 High End Show in Munich.




The MQA "Digital Origami" folding process, where the very high frequency content (C), and high frequency information (B) are losslessly compressed and hidden beneath the noise floor of the regular CD-quality component (A), which is stored normally.

is empty—it's inefficient and because you can't tell where the music's essence is, it's hard to lift it out undamaged."

Unlike the huge files from super-high-sample-rate systems, the MQA file is efficiently encoded and it contains and protects all the sound of the original. The end result file or stream combines metadata with details of the recording, instructions for the decoder and D/A converters, plus how to create an authenticated exact reconstruction of the original analog signal—an indicator that authenticates what we are hearing is a true rendition of the original master recording.

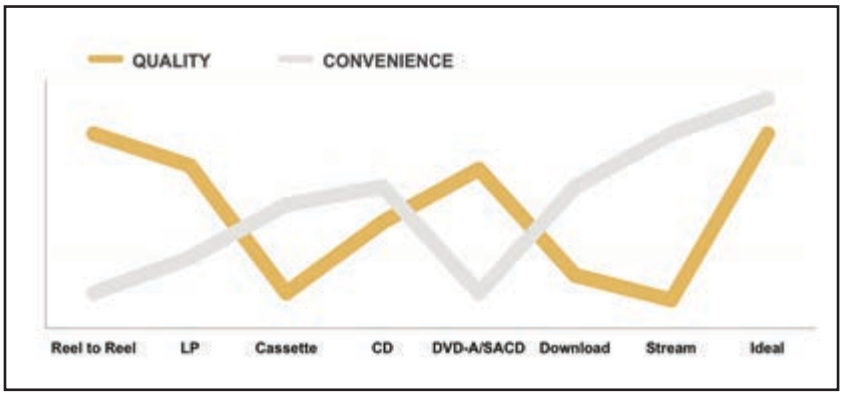
That file is not a new format. An MQA file can be delivered inside any lossless container as ALAC, FLAC, or WAV. The result can be decoded on software or hardware—and it works for all masters between 44.1 kHz and 768 kHz sampling, at any bit depth.

Some of the disclosed information indicates any MQA-encoded file, when downloaded, can be saved and played back by any existing equipment capable of playing 24-bit PCM at 44.1 or 48 kHz (the MQA-encoded file can be a 16- or a 24-bit file). Since MQA is a PCM stream it can even be played back from a CD, or streamed from existing services. As it has been confirmed, MQA encoding could even potentially be applied to digital radio and event streaming in the future.

## How It Works

The MQA decoder knows what the file is and can optimize the DAC performance based on that information (it will never perform downsampling). Average data rates will depend on whether the original is a 16/44.1 Redbook source or 24-bit at high sampling rates or even a DSD source. According to MQA this should result in variable data rates from 500 kbps to 1.5 Mbps. For guidance, we could say that an MQA file from a 24-bit/192 kHz recording will result in the same approximate size of a 16-bit/44.1 kHz WAV file.

The MQA decoder displays when the unit is decoding and playing an MQA stream or file, while the "MQA Studio" designation indicates it is playing a file that has either been approved in the studio by the artist/producer or has been verified by the copyright owner.

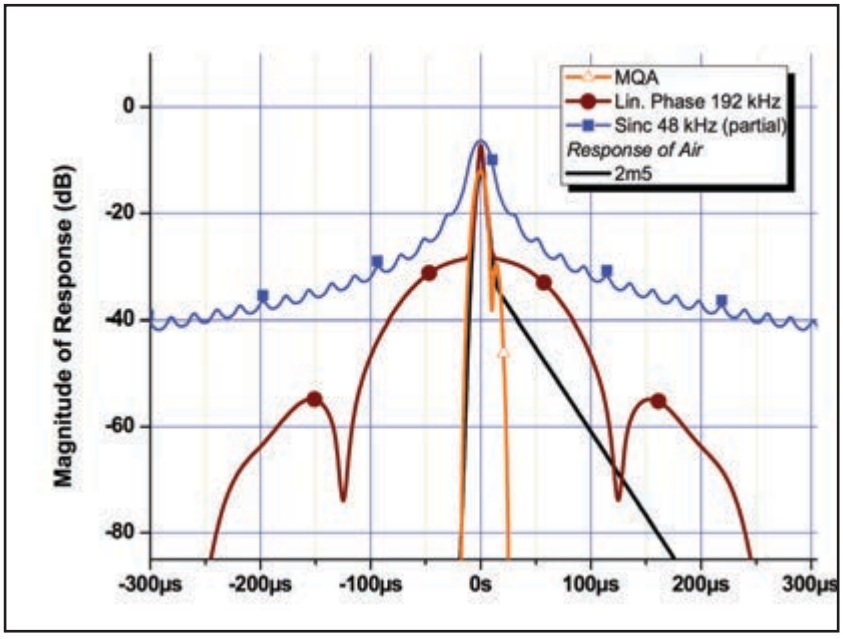



The MQA target of convenience and quality compared to existing distribution formats.

The decoding stage should always take place at the end of the process, when converting to the analog domain, so it is independent of any interfaces and digital transmission format and it can even be built-in directly into the speaker.

As MQA states "MQA authentication is not a proxy for a Hi-Res definition." If the player is not equipped with or connected to an MQA decoder, the MQA file plays as a standard PCM file—so it can still be decoded by any existing digital player—and the results will be different, since they originate from a new mastering process: from an analog master directly to MQA or from an existing digital master re-coded to MQA, potentially benefiting from the latest technology.

That digital file might be a 16-bit/44.1 kHz master in FLAC/ALAC or a high-resolution 24-bit/192 kHz PCM, or a DSD converted to PCM, with the resulting MQA encoded version of that same file being a smaller, more convenient file. At approximately one-tenth the size or equivalent bit rate, it is manageable for everyone.




MQA impulse response is compared to common digital audio filters, illustrating the accuracy of time resolution and smearing of a transient. MQA reduces ringing, and hence smearing, by more than 10 times compared to an ordinary 24 bit/192 kHz recording.

Anyone content with sourcing true digital high-resolution recordings and those who have already invested tens of thousands of dollars in equipment to store and playback those files with the best DACs and audio-chains in existence, and don't feel frustrated by the limited choice of content, probably aren't too concerned about convenience.

Still, high-end audio enthusiasts who have already started evaluating the limited available MQA content, are praising its qualities and are focusing on the benefits of better digital audio reproduction and quality-assurance of the origin of MQA files, as compared to much of the existing high-resolution audio content of diverse and often uncertain origins.

Whether or not you believe in the merits of the MQA coding of a digital file, the MQA content will always be at least as good as what we had before, in a convenient package for current mainstream distribution methods: downloads and streaming.

And this is why I believe MQA is so important. It goes back to the best existing source of music. It combines high-quality encoding of the master recordings. It makes lossless high-resolution audio downloads and streaming practical. And, most importantly, it combines encapsulated metadata to ensure that consumers can identify the quality of the encoded content while, simultaneously, allowing decoding of the content by non-MQA compatible systems, when not available.

In my opinion, this is the perfect embodiment of a solution that both protects and respects consumers. A consumer has a right to quality audio—as close to the master recording as possible. MQA also offers convenience. Convenience, more than marketing, will be the most effective way to promote higher-quality audio.

## The Questions

Of course, for a new and disruptive technology such as this, there are many open questions, while business decisions and licensing terms are still being confirmed. More technical details, including the encoding process and studio tools are being published, as they are being disclosed, in MQA's blog (see References).

One of the technical questions raised is that the MQA encoding and folding process might generate audible noise when the file is played on a non-MQA system. As we have personally experienced, this is not the case, since that noise is shaped to sit below

the threshold of hearing, even for extreme acoustic gains. In our interviews, we were also told that in the studio it is possible to manage how much information it is effectively "folded" and encoded under the noise floor, so it does not impact the decoded audible result (MQA or non-MQA). Since the decoder manages the "unfolding" process, any shaped noise should always fall below that of the CD release.

Other questions address the idea that MQA is another "closed-system" or that its "authentication" philosophy would be similar to a digital-rights management (DRM) scheme. As already described, MQA licenses the use of the encoding process to studios and record companies and licenses decoders to audio manufacturers and certifies the implementation. Other than that, it doesn't enforce restrictions in terms or platform interfaces and certainly, no DRM restrictions. An MQA-encoded file can still be copied and it plays in any player—hardware or software—with or without a decoder. There is also no tracking or copy protection involved. The MQA metadata only confirms provenance to the MQA decoder, as described.

## Interview with Spencer Chrislu

Other questions we had, were more focused on practical implementation, the creative aspect, and the business plan. To address those questions, we interviewed Spencer Chrislu, MQA's Director of Content Services, who has been involved in the music industry for his entire working life. Chrislu is an electrical engineer, who worked as a mastering engineer and producer for many years, including as a sound engineer for Frank Zappa & the Zappa Family Trust until 1998. Before joining MQA, he spent a decade working for Warner Music Group, where he was also Vice President in charge of digital operations and helped create their archive specification and manage the archives through it. That's how he met Stuart and his involvement with MQA started.

*audioXpress*: How easy will be for content producers—recording and mastering studios—to generate MQA content?

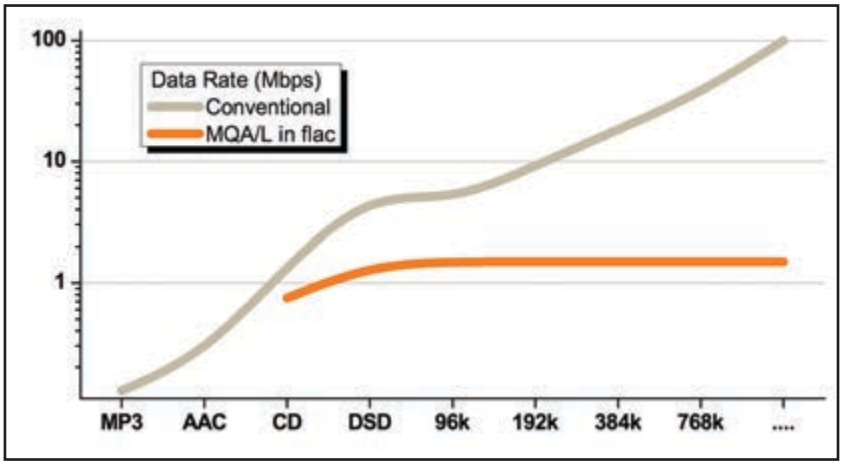
Spencer Chrislu: I cannot reveal yet all of the things that are involved in the creation process – that is part of the patent process that we are still under. But we are going to make tools available in the studio. There will be a plug-in that will go inside a digital audio workstation (DAW) and there will be an MQA-enabled DAC. And by listening through this chain, the plug-in will tell the DAC what to do.


An inspiring moment occurred at the ALMA Symposium 2016, when Bob Stuart discussed the hearing mechanism and neural processing of sound, psychoacoustics, perception, digital audio and sampling, high-resolution audio, and the new Master Quality Authenticated (MQA) technology during a two-hour seminar.

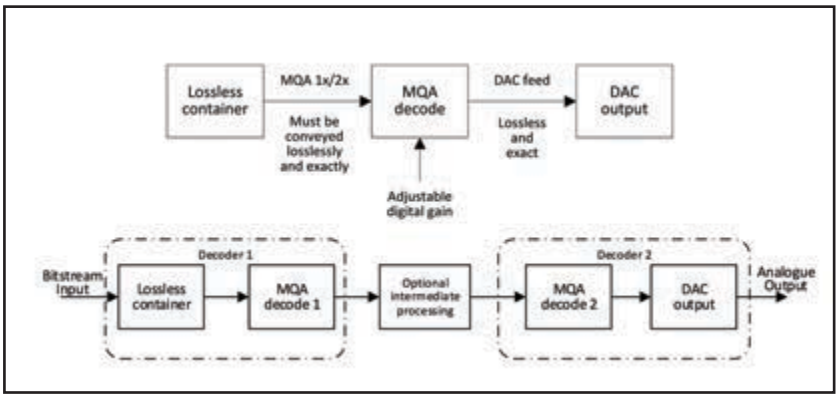
The toolset will also create a digital signature to feed the encoder and feed the parameters that get handed to the encoder. Then the encoder will generate the files for distribution.

*audioXpress*: Yes, but how do you know which information is relevant, depending on the source? If information should be there at all... When we go back to early PCMs, we find masters where the information has already been removed by the limitations of the technology at that time.

Chrislu: Correct, that's part of our work. There is a whole era of things that when the master is 16-bit at 44.1 kHz, that is the master. You can call it limited... But I've heard 16-bit/44.1 kHz on some recordings that sounded a lot better than 24-bit/192 kHz of others. So it's actually not about the numbers, per se, it really is about creating the master, and capturing the master. We have found ways of unlocking that even in the earliest of recordings. Morten Lindberg (2L and Lindberg Lyd) is very proud of one of its first recordings—that we have on demo—of the Nielsen piano concertos, done on a PCM DAT recorder (Sony PCM-2700, in 1993, according to the 2L website).




This is a data rate comparison between a high-resolution FLAC file and the equivalent MQA-coded file in FLAC.




The diagram shows the ideal implementation of an all-in-one MQA decoder. The decoder has a control for gain, optimized for the DAC. The lower diagram shows how to implement additional processing.


With extensive experience in the recording and the music industry, Spencer Chrislu's job consists of getting as many studios, record labels, and content providers involved with MQA as possible.

Spencer Chrislu, MQA's Director of Content Services, gives a presentation at CES 2016.

Bob and Morten were able to piece back to the exact sound in the room—and they were able to do it because Morten still had the original A to D and we could run signals through it and understand how it was distorting things in the time domain, and then take those things out.

When you know the profile of what PCM recorders do to audio, you can reverse that out. The information that comes out of these things is unbelievable. But that's more of a restoration thing.

The plug-in is actually more for the studio. Mastering engineers will be able to hear it and not only have the choices on how it folds and the way it folds, but they can hear a 192k file fully unfolded and folded at 96k, folded at 48k, and unfolded to legacy—where someone doesn't have a decoder. Then they can make those mastering choices and decide creatively if it revealed what they wanted to reveal.

It's an interactive tool in that sense. The cool thing—and the guarantee of MQA—is that what comes out of its D/A converter, analog, is the same that will come out of anyone's D/A converter. That's part of what the promise of MQA is about. That's why we call it an end-to-end system. It is about joining the analog to the analog, and removing the distortions that get in the way.

Digital actually becomes the transport mechanism. It's a very convenient transport mechanism, but the key is the analog on each end. Obviously we experience everything in analog and that's what it's about.

*audioXpress*: Are we able to see what you are explaining with very objective metrics?

Chrislu: We have objective measurements. You can see the impulse response of an MQA system versus the best possible overall end-to-end response of a 192 kHz/24-bit system.

But where I think we really strike a chord is when we play it to the artist themselves. When a famous guitar player who obviously knows what his guitar sounds like and what his guitar amp sounds like, listens to the MQA process and says: "Stop. I haven't heard that since the day we recorded it!"

We've talked to the vocalists, to the mastering engineers, to people like Morten who has been recording these things since ever, and when we apply the MQA process they say, "That's it!"

I have my own recordings that I've done with Frank Zappa and they're 16-bit/44.1 kHz, and when I put them through the process I was right back to where it was when it was live.

*audioXpress*: Do you believe MQA can go mainstream?

Chrislu: I truly believe so. And I believe it for all the right reasons. If you break it down logically, it almost has to be mainstream. If you think about just the artistic process, we have artists that actually spend more time on their records these days, in the era of MP3… than they actually did in the era of the Beatles and the Rolling Stones. They spend more time putting the subtlest nuances, the subtlest tweaks into things that get absolutely ripped apart and destroyed by MP3s. From an artistic point of view, this is something that will resonate and already has resonated with them.

From a producer's point of view, his job is to make sure that he is bringing the artist's work to life in a way that is collaborative and satisfies what they want from the collaborative process. If it gets thrown away by streaming services, if it gets thrown away by a download, what's the point? Right? It will resonate with him.

From a label's point of view, a label has the responsibility to take the work of an artist who they've signed—they have given him money to do this—so they have a responsibility to take that art and present it to everyone in the best possible way. Why present it in anything less than its best possible light? Before this, their excuses have been "we can't possibly do that, because the files are too big. No one would ever download it…"

Morten Lindberg (pictured during a 2L recording session) offers additional detail about how the MQA was applied to his earlier recordings. (https://shop.klicktrack.com/2l/468051).

*audioXpress*: "…No one will notice the difference…"

## Resources

2L The Nordic Sound, www.2l.no.

2L Music Store, Carl Nielsen Piano Music, https://shop.klicktrack.com/2l/468051.

"A Comprehensive Q&A With MQA's Bob Stuart," The Computer Audiophile, April 2016. www.computeraudiophile.com/content/694-comprehensive-q-mqa-s-bob-stuart

P. G. Craven, "Antialias Filters and System Transient Response at High Sample Rates," *Journal of the Audio Engineering Society* (*JAES*), Vol. 52, No. 3, March 2004.

M. A. Gerzon, P. G. Craven, J. R. Stuart, and R. J. Wilson, "Psychoacoustic Noise Shaped Improvements in CD and Other Linear Digital Media," 94th Audio Engineering Society (AES) Convention, Berlin, March 1993.

H. M. Jackson, M.D. Capp, and J. R. Stuart, "The audibility of typical digital audio filters in a high-fidelity playback system," Paper presented at the 137th AES Convention, 2014.

M. Lewicki, "Efficient Coding of Natural Sounds" Center for the Neural Basis of Cognition & Department of Computer Science, Carnegie Mellon University, http://dx.doi.org/10.1038/nn831.

MQA, www.mqa.co.uk

MQA detailed technical description videos, The Hans Beekhuyzen Channel, https://youtu.be/r_wxRGiBoJg and https://youtu.be/T5o6XHVK2HA.

"Streaming Audio: Preserving the Past, Protecting the Future," Rocky Mountain Audio Fest (RMAF) Session, https://youtu.be/cxyvVXPmJ0o.

J. R. Stuart and P. G. Craven, "A Hierarchical Approach to Archiving and Distribution," Audio Engineering Society (AES) Paper, presented at the 137th AES Convention, 2014, www.aes.org/e-lib/browse.cfm?elib=17501.

J. R. Stuart, "High-Resolution Audio - A Perspective," *Journal of the Audio Engineering Society* (*JAES*), Vol. 63, No. 10, October 2015, www.aes.org/e-lib/browse.cfm?elib=18046.

——, "Coding for High-resolution Audio Systems," *Journal of the Audio Engineering Society* (*JAES*), Vol. 52, No. 3, March 2004.

Chrislu: But the label doesn't actually have to make that call about who notices or doesn't notice… When the technology is there, I think they have a moral responsibility to present it in the best possible way.

And then you have the fans. We raised an entire generation to expect less from music, to devalue music. Now, we have a big reeducation process to do. That only comes from exposure really. You can market it all you want and you can tell people it's going to be the best thing in the world, but the real key to this is when they've experienced it.

If we go back to where we were in the era of vinyl—when you bought a record, you bought the same record that he bought and I bought. It was the same source. How you chose to play it back it was up to you.

I could put the record on a plastic player and hear it from plastic speakers! Others could play it through $10,000 tube amplifiers, but it was the same source.

We have to get back to that idea that there is one source and that it has the highest resolution, so it has all the information in it. How you choose to consume it, how you choose to enjoy it, is now up to you and there are no limitations. Take it with you on the train or in the car, listen to it on your high-end system or stream it through all the wireless speakers in your house. It doesn't matter because the source has all the information in it. That, I think, is the key to this.

*audioXpress*: So that's why you have focused on the creation, on the relationship with the record labels, so you can generate better content first?

Bob Stuart is a graduate of Imperial College London, where his studies included Psychoacoustics and Electronic Engineering. He is also the brains behind Meridian Lossless Packing (MLP), the audio technology at the heart of DVD-Audio, and now part of the Blu-Ray disc specification. MLP technology was a significant development by Meridian, enabling the delivery of higher-quality stereo and surround sound by reducing the audio signal's file size or required bandwidth without causing a reduction in quality (as experienced with lossy compression, e.g., MP3s). MLP made it possible to provide high-quality audio within the existing bandwidth or media limitations. On replay, the original signal is recovered with guaranteed bit-for-bit accuracy. MLP was originally mandated for inclusion in the DVD-Audio format, and is now part of Dolby TrueHD, which is part of the Blu-ray disc format. In 2015, CEDIA, the Custom Electronic Design & Installation Association, awarded Bob Stuart with a Lifetime Achievement Award.

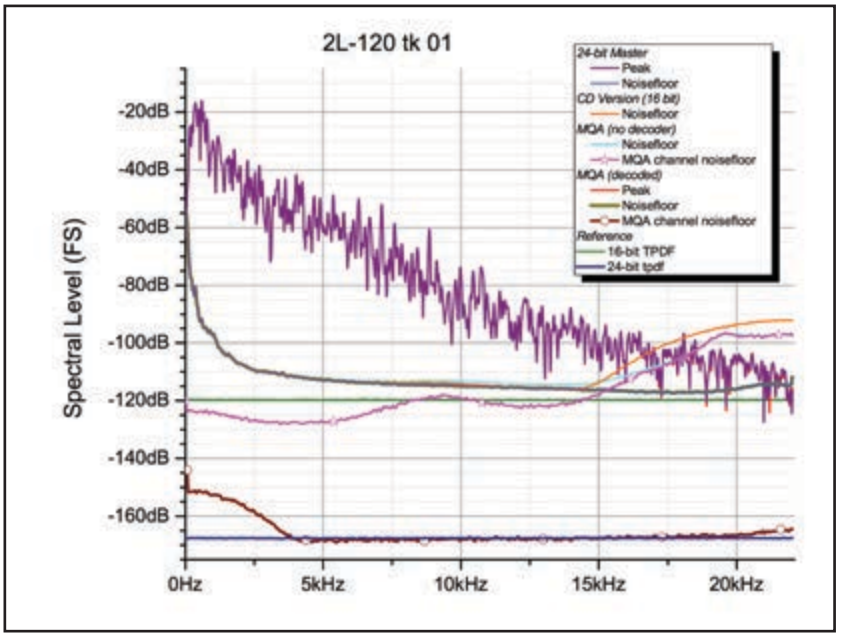
Bob Stuart is MQA's founder and one of the main inventors of Master Quality Authenticated (MQA) technology.

Chrislu: Yes. And it will work in two ways. The label themselves have huge archives of material. They have a number of high-resolution material and some standard CD material, that is the master. When they process that, it will mean that the market gets a lot of content. It doesn't become the SACD model, where everyone has to wait for a reissue and you get 10 releases in the first year, 100 in the second year, and 150 in the third… It took 10 years to get to 1,000 releases! That doesn't really satisfy the public needs.

There will be a curve of new releases that drives the market from the very beginning. There is only the source, the one source of truth that the artist and the producers themselves said that "this is the master I want to hear" and it gets to everybody. Exactly as they've heard it in the mastering room.

*audioXpress*: That's why introducing MQA to streaming is so important, since there is no way around it these days.

Chrislu: Correct! And for a cost of 1.1 Mbps you get the world's catalog as the master tapes!




The spectrum level diagram for the Nielsen piano 2L-120 Track 1 file shows that 2L's Original, CD, and MQA versions of the files are consistent in level and response. The graph also shows inherent noise-floor with and without MQA decoding, a comparison of the background noise throughout each version, and the reference level for 16-bit TPDF dither in a channel sampled at 44.1 kHz. The 24-bit Master and the MQA (decoded) peak noise curves overlay and are not separately visible.

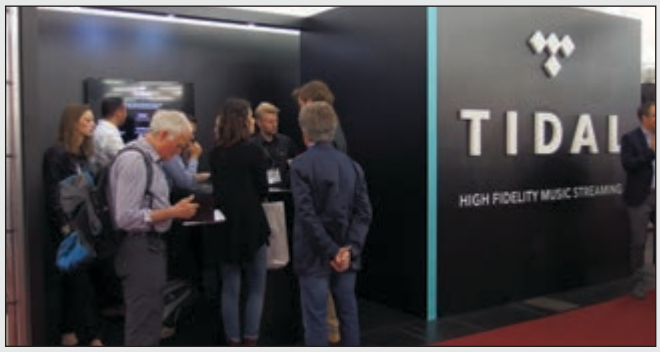
## MQA—The Timeline

Originally introduced during a special event in London, in early December 2014, Master Quality Authenticated (MQA) promised to "change the way people enjoy music all over the world," introducing the "missing piece of the high-resolution audio puzzle."

Following that presentation and a series of strategic meetings and private demonstrations, MQA quickly received broad support from the music industry, artists, recording and mastering engineers, and record labels. During CES 2015, in Las Vegas, NV, several announcements from audio manufacturers and digital music distribution services confirmed the technology was going to reach the market.

At CES 2015, Norwegian lossless music streaming service TIDAL announced its MQA integration, even though it didn't confirm when the service would be available. Also crucial was support from Imagination Technologies, which confirmed at CES 2015 that its Caskeid wireless audio IP platform would become the first multiroom streaming solution to support MQA, enabling licensees of the Caskeid family of wireless audio streaming technologies to have access to a high-resolution wireless audio solution. Among the licensees and partners of Imagination's platforms are companies such as Frontier Silicon, Onkyo and Pure. Meridian Audio also licenses Caskeid.


Meridian Audio's Special Edition DSP8000 Digital Active Loudspeakers receives an MQA digital stream from a Meridian Sooloos digital player at High End Show 2015.




Tidal was the first streaming music provider to adopt and demonstrate MQA working on its service, using comparable data rates to its regular "Hi-Fi" stream using FLAC at 1411 kbps.

At that time, Imagination also confirmed it would be working closely with the 7digital B2B digital music platform, which was also an MQA early supporter, to ensure access to a rich catalog of MQA-encapsulated tracks.

In May 2015, at the High End Show in Munich, Germany, Bob Stuart announced that MQA was now a separate company and that its technology would be available as an open license. The company, MQA, Ltd., also confirmed active discussions with more than 100 potential business partners, and new agreements with Onkyo and British hi-fi manufacturer, Arcam.

In August 2015, Bluesound confirmed its future roadmap would include adoption of MQA and its intention to be among the first manufacturers to introduce MQA in a future upgrade, as soon as content becomes available.

During IFA (Internationale Funkausstellung) 2015, in Berlin, Germany, the Pioneer XDP-100R Digital Audio Player was unveiled


The Meridian 808v6 Compact Disc, USB and network source player, part of its 800 Reference Series, now also decodes MQA sources. (It retails for $22,000.)


The Pioneer XDP-100R portable player, and its brother, the Onkyo DP-X1, are the first portable solutions to playback MQA files.

as the industry's first portable player to offer MQA. And since Onkyo and Pioneer Electronics combined their businesses in September 2014 (they are now Onkyo and Pioneer Innovations Corp.), it was also announced that OnkyoMusic, a high-resolution music download service, would support MQA.

In October 2015, at the Rocky Mountain Audio Fest (RMAF), MQA introduced a new logo and revealed that Mytek Digital and AudioQuest would support MQA. RMAF 2015 saw the world premiere of the Myteq Brooklyn USB DAC, preamplifier and headphone amp, supporting DSD and DXD, with the promise of MQA with a future firmware upgrade. Additionally, Meridian introduced the latest generation of its 808v6 Compact Disc, USB, and network source player, part of its 800 Reference Series, specifically developed to decode MQA sources (which retails for $22,000).

Meridian also provides the simplest and most affordable DAC in the market to decode MQA: the Meridian Explorer 2 for $299.

For developers, MQA is available in a series of platforms and technologies for implementation in all sorts of products. Imagination Technologies also provides MQA support for its Caskeid wireless audio IP platform.

At CES 2016, the company confirmed major new partnerships with content and hardware companies, as well as new development platforms for manufacturers wishing to support the MQA format. At CES 2016, MQA also confirmed agreements with music download store 2L and playback support from AURALiC, Aurender, Berkeley Audio, dCS, Kripton, Ixion, and HTC, which equipped its HTC One A9 smartphone with MQA technology in a "proof of concept."

2L claimed the honor of first label to offer music in MQA. Founded by Morten Lindberg—a highly respected figure in the world of digital music recording and a Grammy multi-nominee—the Scandinavian music label worked extensively with Bob Stuart in the early experiments with MQA. 7digital, HQM (Japan), OnkyoMusic and TIDAL all confirmed they would offer MQA content in 2016.

MQA also offered decoder implementations for an expanding range of platforms, allowing content and playback partners to quickly and easily incorporate MQA into both existing and new products.

An XMOS reference decoder board was demonstrated to help drive product design ideas for future MQA implementations. In addition, the decoder has been ported to a growing range of platforms, and pre-compiled MQA libraries were announced for Microchip's PIC32, ARM's A7 and A9 processors, and Imagination's MIPS processors. X86 and Linux implementations, as well as FPGA with Analog Devices' SHARC+, Microchip's CY920 and Synopsys ARC (AS221BD) were also announced.

Just a week later, digital music and radio services company, 7digital, announced its first content available in MQA, supporting the onkyomusic.com store and plans to introduce MQA in further services from its 46 B2B clients in 33 countries. 7digital also distributes the MQA catalog from Lindberg's label 2L.

In April 2016, Meridian Audio launched a firmware update enabling MQA playback in its own extensive range of compatible products, including the Meridian Explorer2 pocket USB DAC, which is now the most affordable MQA decoder available. As promised at IFA 2015, MQA also became available on the Pioneer XDP-100R and Onkyo DP-X1 portable devices.