

MQA – a clever stealth-DRM-Trojan

Dr. Christoph Engemann

Dr. Anton Schlesinger

34C3 Leipzig Germany

MQA – A CLEVER STEALTH-DRM-TROJAN

MQA

=

Master Quality Authenticated

AGENDA

- ▶ 1. Audiophiles...? Audiofiles! (Christoph)
- ▶ 2. MQA claims examined (Anton)
- ▶ 3. 24bits: got some room to spare (Christoph)
- ▶ 4. Clever (Anton & Christoph)
- ▶ 5. Q&A

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Audiophiles...? Audiofiles!



The screenshot shows the homepage of the James Randi Educational Foundation. At the top left is a portrait of James Randi, an elderly man with a white beard and glasses. To his right is the organization's name in a large, bold, serif font: "James Randi Educational Foundation". Below the name is a stylized signature of "James Randi". At the bottom of the header is a navigation bar with links: "HOME" (which is highlighted in a light gray box), "SWIFT", "ABOUT", "EDUCATION", and "JREF PRESS".

<http://web.randi.org/>

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Audiophiles...? Audiofiles!



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Audiophiles...? Audiofiles!



James Randi Offers \$1 Million If Audiophiles Can Prove \$7250 Speaker Cables Are Better



Charlie White

10/01/07 11:22am • Filed to: CALLING BULLSHIT ▾



340.1K



105



1



Dave Clark



[Click to view](#) Our [rant about those \\$7,250 Pear Anjou speaker cables](#) found its way to the James Randi Educational Foundation (JREF), and Randi offered \$1 million to anyone who can prove those cables are any better than ordinary (and also overpriced) Monster Cables. Pointing out the absurd review by audiophile Dave Clark, who called the cables "danceable," Randi called it

"hilarious and preposterous." He added that if the cables could do what their makers claimed, "they would be paranormal."

<https://gizmodo.com/305549/james-randi-offers-1-million-if-audiophiles-can-prove-7250-speaker-cables-are-better>

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Audiophiles...? Audiofiles!



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Audiophiles...? Audiofiles!

The Sensation of Speed

Blistering Fast 240Hz Refresh Rate

240Hz

GSYNC

1ms



Audiophiles...? Audiofiles!



Audiophiles...? Audiofiles!

John Carmack @ID_AA_Carmack

Following

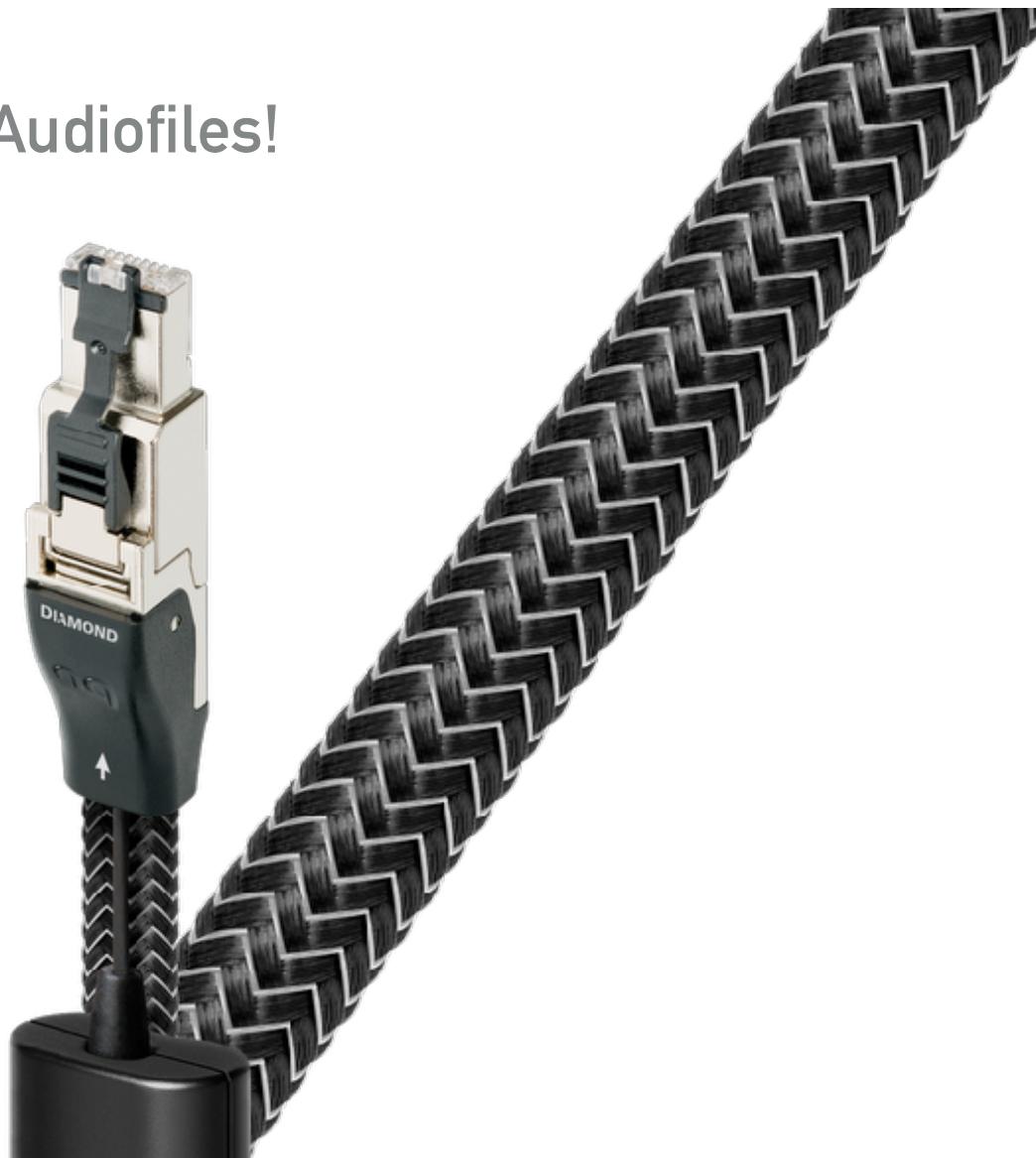
A peak responsiveness PC shooter should drive a variable sync monitor off of the USB HID clock. No CPU/GPU pipelining, of course.

7:55 PM - 5 Sep 2017

This image shows a screenshot of a Twitter post from John Carmack (@ID_AA_Carmack). The post contains a tweet with a profile picture of a cartoon character surfing, the author's name and handle, a blue 'Following' button, the tweet text, and the timestamp. The background of the screenshot is dark blue.

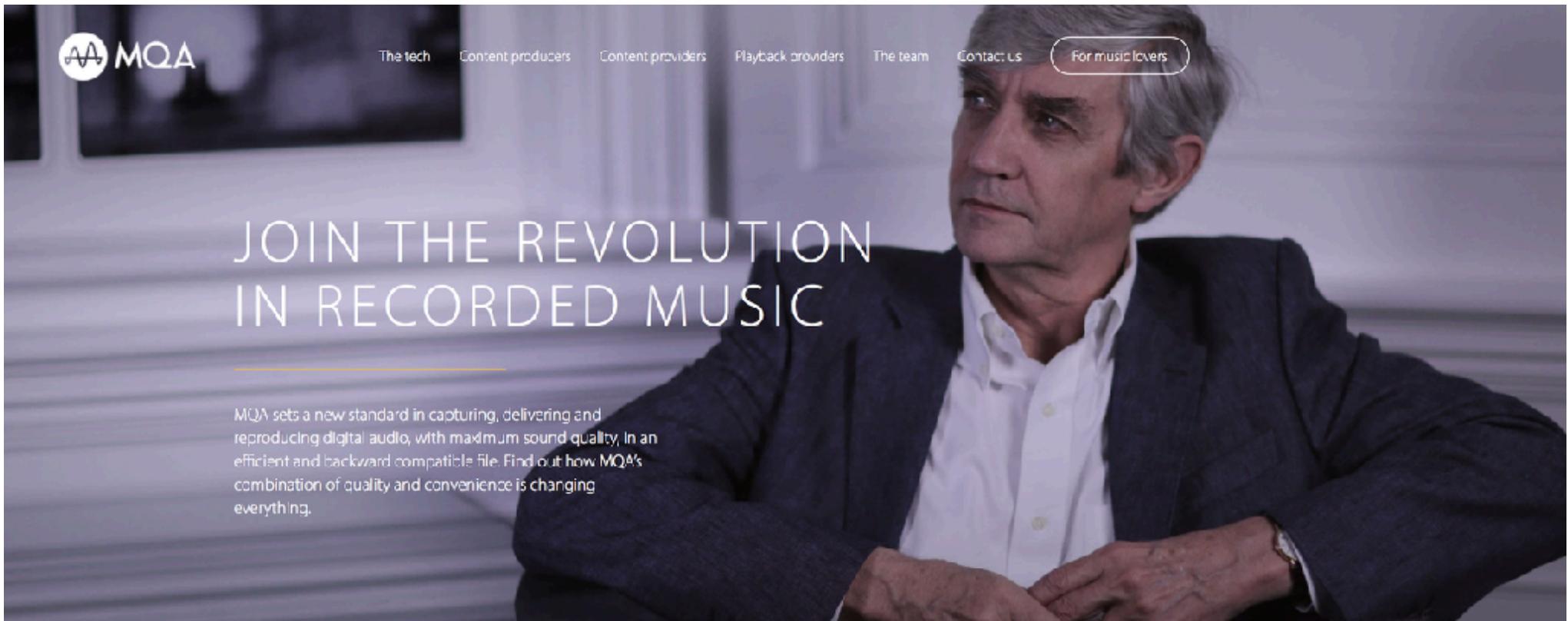
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Audiophiles...? Audiofiles!



MQA – A CLEVER STEALTH-DRM-TROJAN

Audiophiles...? Audiofiles!

The background image shows a middle-aged man with grey hair, wearing a dark suit jacket over a white shirt, sitting in what appears to be a studio or office setting. He is looking off to his left with a contemplative expression. In the background, there's a window showing a blurred outdoor scene, possibly a beach or coastal area. The overall lighting is soft and professional.

The MQA logo (a stylized 'M' inside a circle) is located in the top left corner of the image.

The top navigation bar includes links: The tech, Content producers, Content providers, Playback providers, The team, Contact us, and a highlighted button labeled For music lovers.

**JOIN THE REVOLUTION
IN RECORDED MUSIC**

MQA sets a new standard in capturing, delivering and reproducing digital audio, with maximum sound quality, in an efficient and backward compatible file. Find out how MQA's combination of quality and convenience is changing everything.

MASTER QUALITY
AUTENTICATED

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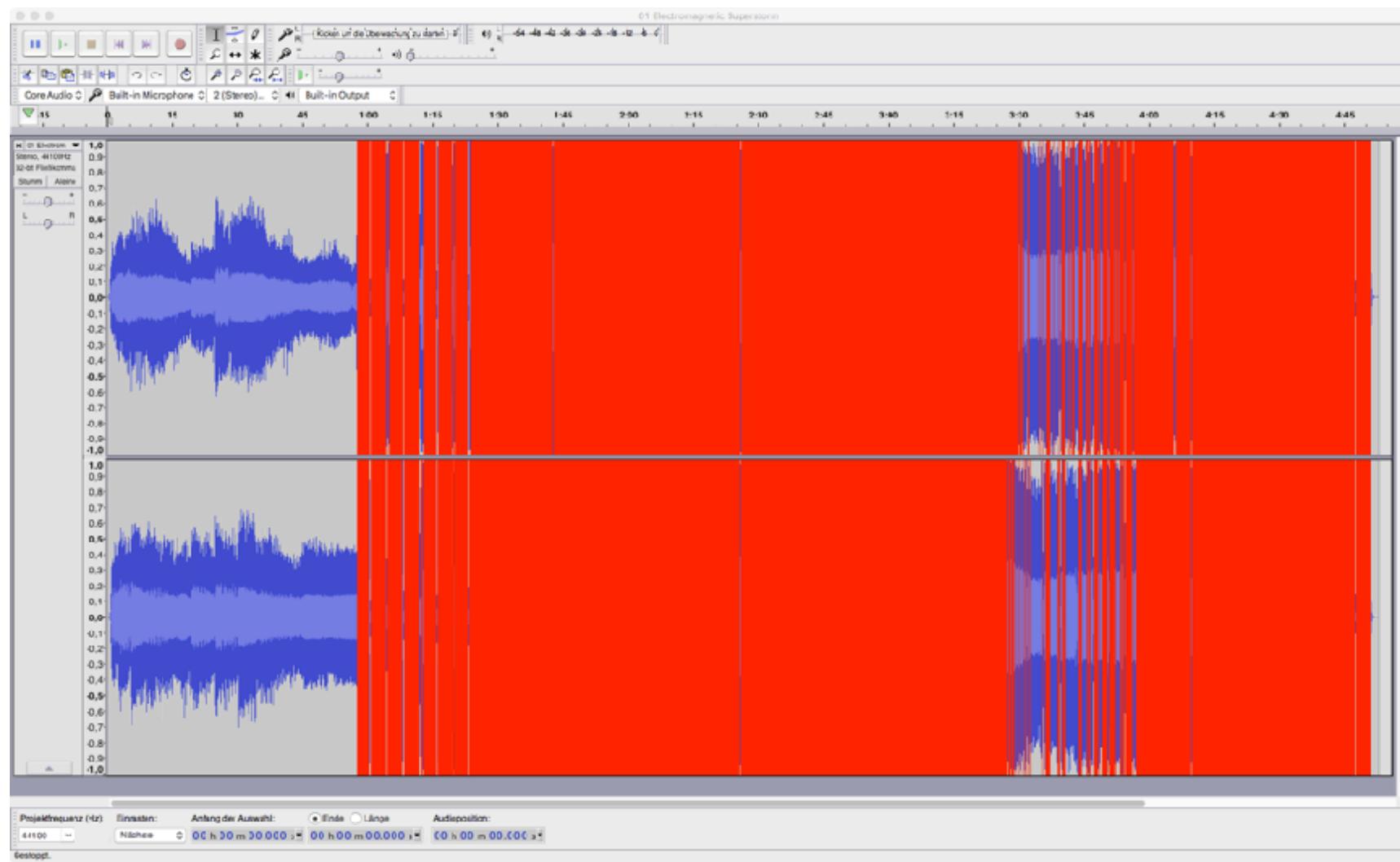
Audiophiles...? Audiofiles!



<http://www.presidentevil.de/>

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Audiophiles...? Audiofiles!



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Audiophiles...? Audiofiles!



with Axlander Semrow at Hansa Studio: <http://www.hansastudios.de/english/>

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Audiophiles...? Audiofiles!



<http://www.beatrix-becker.de/>

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Audiophiles...? Audiofiles!

The image shows a woman with blonde hair wearing a patterned shirt, her hands resting on a dark electronic keyboard or synthesizer. In the background, a larger keyboard with the brand name 'prophet' visible is being played by another person. The website's navigation bar at the top includes links for 'How it works', 'Our partners', 'Artist story', 'News and events', 'Press', 'Contact us', and a button for 'For music professionals'. The main headline 'TAKE ME THERE' is overlaid in large white letters, followed by 'THE ARTIST STORY' in a smaller font. Below the headline, a subtext reads: 'MQA reveals every detail of the original recording. US artists Smoke Season explain why that detail is so important.' A call-to-action button says 'Watch the video >'. At the bottom, there are links for 'For music lovers' and 'For music professionals', along with a 'Sign up for updates >' button. Social media icons for Twitter, Facebook, YouTube, and LinkedIn are at the very bottom right.

MQA

How it works Our partners Artist story News and events Press Contact us For music professionals

TAKE ME THERE

THE ARTIST STORY

MQA reveals every detail of the original recording.
US artists Smoke Season explain why that detail is so important.

Watch the video >

Scroll down

For music lovers For music professionals Sign up for updates >

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Audiophiles...? Audiofiles!

28C3 - Version 2.3.5

28th Chaos Communication Congress
Behind Enemy Lines

What is in a name?
Identity-Regimes from 1500 to the 2000s

Starting with the history of birth-registration an overview on the historical regimes of naming and identifying people from the 15th to the 20th century is given. The talk will show examples of the different identity media through time and their standardization with the rise of the Westphalian nation state and the subsequent developments after the French Revolution and during the 20th century. The goal of the talk is to show the complexity of the phenomenon of personal names and their media and the need for an informed debate on who and how naming and identification in the digital age is achieved.

In July 2011 Google opened the social network named Google+, immediately spawning a fierce debate about its real-name policy barring users from opening accounts with pseudonyms. Just a few days later Facebook's Vice President Randi Zuckerberg echoed Google's sentiment, asserting: "(...) anonymity on the Internet has to go away." Finally in early August Germany's minister of the interior demanded an end of anonymity on the Internet.

My proposed talk is not concerned with the relation of anonymity and pseudonymity and free speech, discrimination and empowerment that dominated the 'real-name' "nymwars" on the internet.

Instead it seeks to de-familiarize the notion of the 'real name' by exposing central aspects of the media-history of names, situating personal names in relation to the development of statehood and capitalism between the 1500 and the 2000s.

SPEAKERS	
	Christoph Engemann
SCHEDULE	
Day	Day 1 - 2011-12-27
Room	Saal 2
Start time	20:30
Duration	01:00
INFO	
ID	4713
Event type	Lecture
Track	Society and Politics
Language used for presentation	English
FEEDBACK	
Did you attend this event? Give Feedback	



MQA Authentication

High Resolution

MQA is a superb technology for distributing high-quality recordings. Our goal is to bring listeners the sound of the studio and older recordings from the Archive. MQA has sophisticated tools and methods to recover recordings from all eras including cylinder or shellac, analogue tape or digital right up to modern 768 kHz PCM or quad DSD.

Our viewpoint is that 'Resolution' is a concept of Perception, best interpreted in the analogue domain. This pioneering insight is better aligned to listening experience than to digital domain definitions of quality. As a result, we don't include or exclude recorded material on the basis of digital file format or parameters such as sample rate or bit depth. Instead, we focus on temporal resolution, noise stability and analogue blur. [\[1\]](#)

Provenance

Provenance and technical standards are completely different things. A music file can be altered after artist release, irrespective of the technology used. Provenance is indicated when MQA is played back.

- The MQA 'Studio' (blue light) gives confirmation directly from mastering engineers, producers or artists to their listeners. *MQA Studio* authenticates that the sound you are hearing is exactly as played in the studio when the music was completed and, by implication, that this is also the definitive version of the recording at that point in time.
- A second level, 'MQA' (green light) is available to indicate that although the stream is genuine, provenance may be uncertain or that it is not yet the final release.

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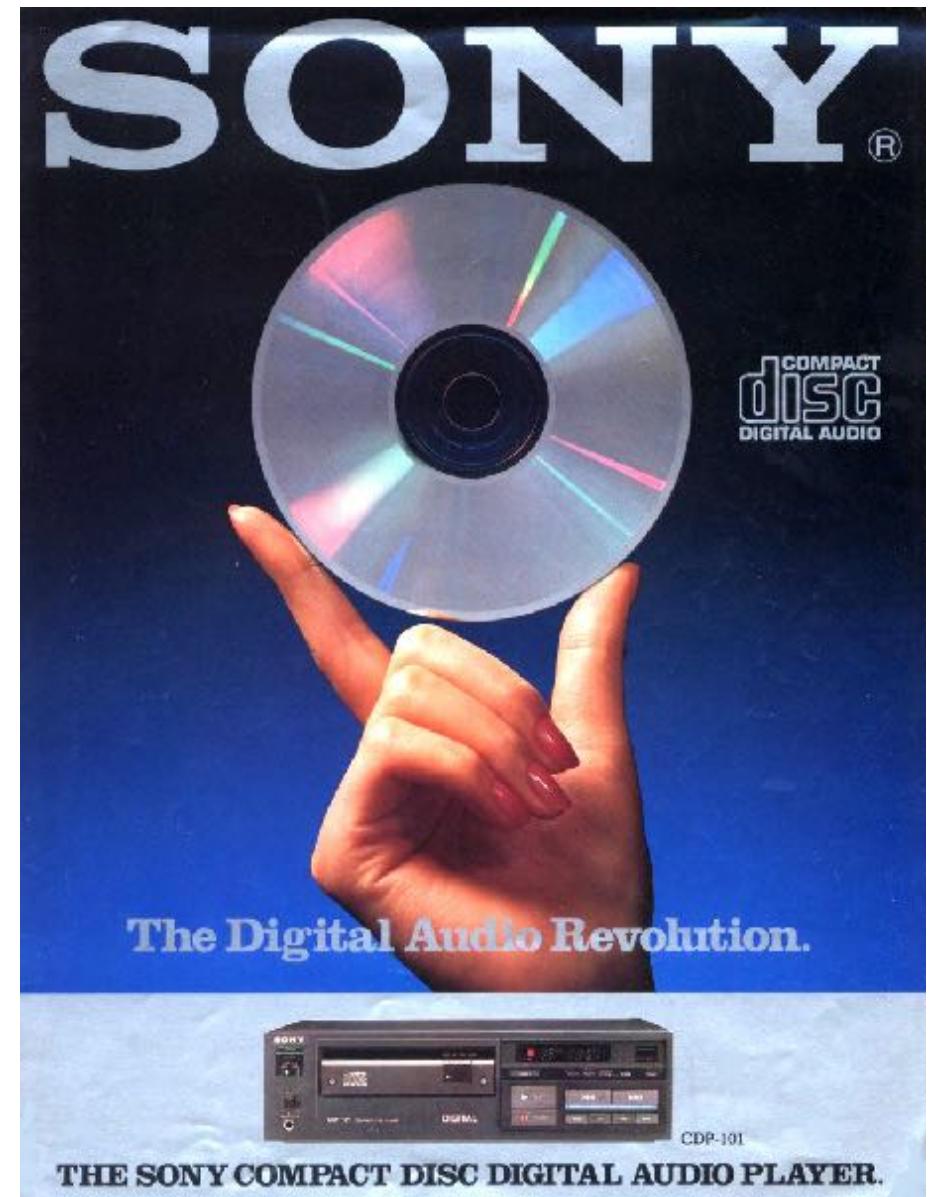
Audiophiles...? Audiofiles!

What is Quality?

Audiophiles...? Audiofiles!

What is Quality?

1980s: digital audio introduced



Audiophiles...? Audiofiles!

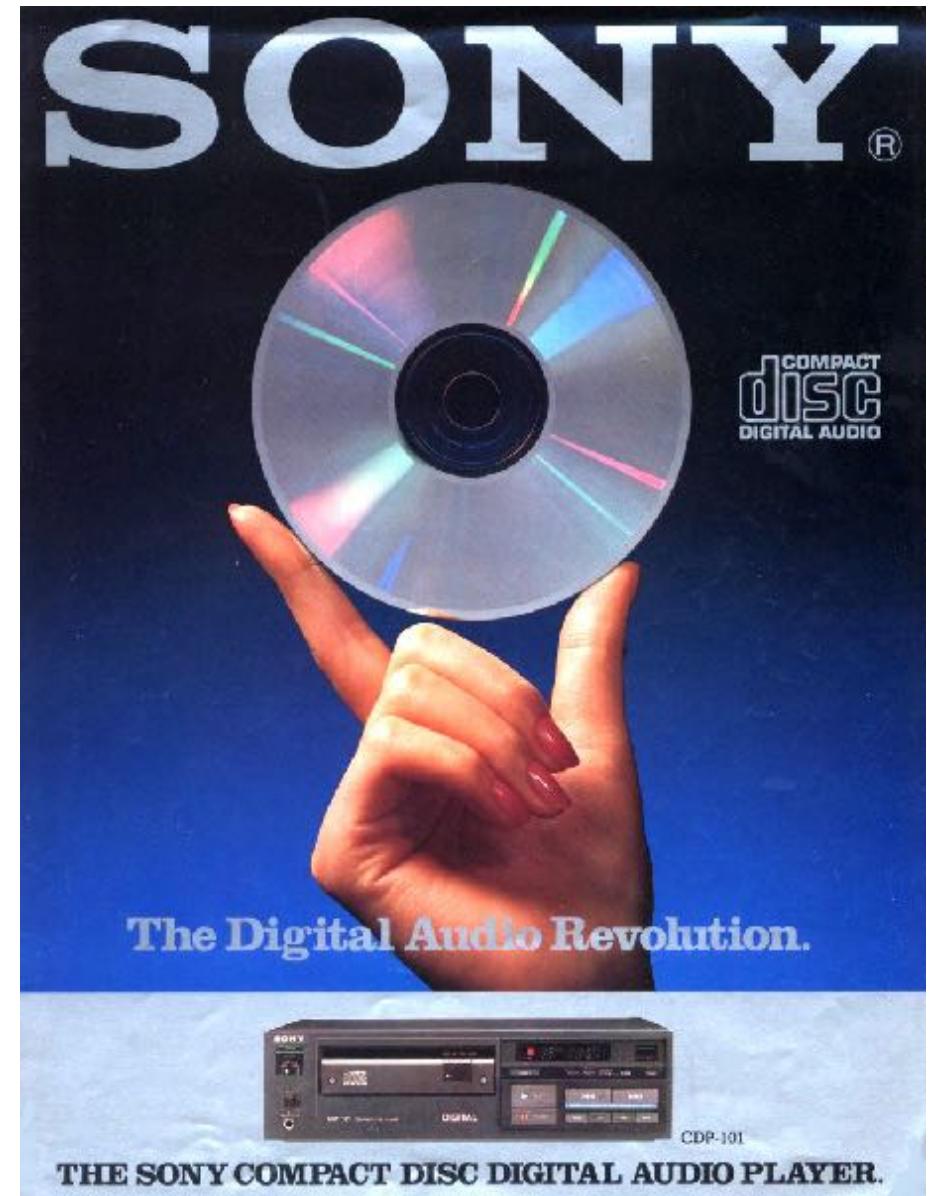
What is Quality?

1980s: digital audio introduced

CD =Redbook Audio Standard

16bit

44.1khz



Audiophiles...? Audiofiles!

What is Quality?

1990s: digital audio workstations

20 and 24 bit converters

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Audiophiles...? Audiofiles!



Audiophiles...? Audiofiles!

What is Quality?

1999: SACD

120db

30khz



SUPER AUDIO CD

Audiophiles...? Audiofiles!

What is Quality?

2000s: MP3

Audiophiles...? Audiofiles!

What is Quality?

2000s: MP3

“convenience beats quality”

Steve Jobs

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Technical analysis of the... Further explained | Mr A... MQA | Engineers mp3 destroying hearing... MP3's are Bad for You -... iPod and Other Audio De... MP3 Accidentally Destro...

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MP3'S ARE BAD FOR YOU

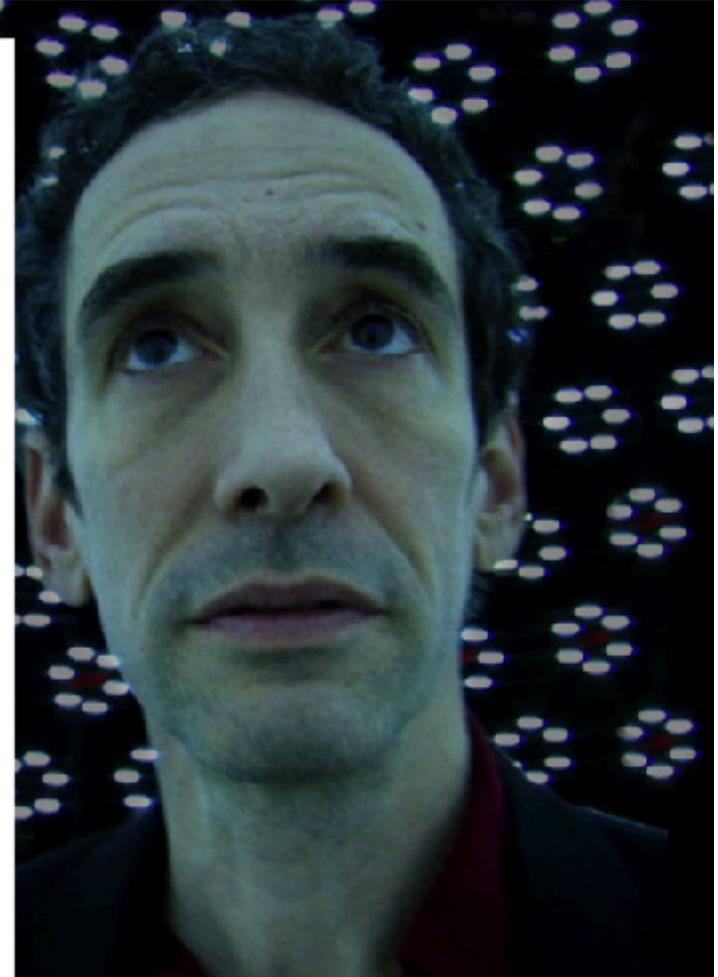
So, on the lighter side, I'm thinking about doing an NPR commentary on the decline in fidelity of digital music formats. Coming from the old world of ips (vinyl disks on which we used to store music as little bumps analogous to the sounds that made them), I've always had a bias against digital sampling as an audio playback medium.

But MP3's, with their ingenius algorithm designed to fool the ear into hearing sounds that aren't there, really seem to destroy the music they are intended to disseminate. To me, they are the audio equivalent of early xerox copies or mid-eighties computer animation. Doesn't anyone else hear (or not hear) the music on mp3s the way I do? They sound as different from recorded music as a Realvideo file is from a 35mm movie.

I found a bit of research on the subject, and there does appear to be a growing camp of audiophiles lamenting what is being done to the ears of America's youth. Will the next generation of music listeners be able to hear reality the same way we did?

And why hasn't the music industry – with a vested interest in stopping the proliferation of MP3's – said anything about this? Would a piece about this be a strategic error?

[f](#) [t](#) [g+](#) [r](#) [in](#) [e](#)



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Audiophiles...? Audiofiles!

What is Quality?

2000s: standalone DACs



Audiophiles...? Audiofiles!

What is Quality?

2010s: Streaming & golden age for audiophiles

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qobuz

UNBEGRENZTE MUSIK DOWNLOAD MAGAZIN WEBPLAYER MEIN KONTO

Ich suche nach einem Künstler, Album, Titel, usw.

Alle Pop/Rock Deutsche Musik Elektro Soul/Funk/R&B Rap Blues/Country/Folk Soundtracks Klassik Jazz Aus aller Welt Lounge Kinder Hörbücher

CHANNEL CLASSICS Der gesamte Hi-Res Katalog zum Spezialpreis

Björk Utopia

Hi-Res AUDIO Gefällt mir 0

Die Crème de la Crème 2017 Die besten Alben des Jahres

NEUHEITEN

All Pop Deutsch... Elektro Soul Rap Blues Soundtr... Klassik Jazz Aus all... Lounge Kinder

NEWSFEED

So. Qobuz | Entdecken Sie den Sound des

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Search



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Rock/Pop	

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Audiophiles...? Audiofiles!

What is Quality?

2014: MQA introduced

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[The tech](#)[Content producers](#)[Content providers](#)[Playback providers](#)[The team](#)

FAQ

How does it work? Is it smoke and mirrors?

MQA is based entirely on science. Specifically, it is based on new findings in Neuroscience that have told us that the resolution of timing information is critical to our hearing and our ear/brain interaction. Standard digital recording and playback (regardless of sample rate/resolution) smears the timing information and thus distorts the musical input. The MQA process can reverse those effects from the music and restore a resolution not heard in any digital playback system to date. MQA Ltd can provide references to all the significant scientific studies for anyone interested.

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MQA Neuroscience



MQA – A CLEVER STEALTH-DRM-TROJAN

MQA Neuroscience



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The MQA logo is located at the top left of the page.

The navigation bar at the top includes: The tech, Content producers, Content providers, Playback providers, The team, Contact us, and For music lovers.

THERE'S A PROBLEM WITH DIGITAL – IT'S CALLED BLURRING

Unlike analogue transmission, digital is non-degrading. So we don't have pops and crackles, but we do have another problem – pre- and post-ringing.

When a sound is processed back and forth through a digital converter the time resolution is impaired – causing 'ringing' before and after the event.

This blurs the sound so we can't tell exactly where it is in 3D space. MQA reduces this ringing by over 10 times compared to a 24/192 recording.

[FIND OUT HOW MQA RESOLVES THE PROBLEM](#)

A large play button icon is located in the bottom left corner of the dark background area.

[For music lovers](#) and [For music professionals](#) links are located at the bottom left.

[Contact us](#) button is located at the bottom center.

[Terms of use](#), social media icons (Twitter, Facebook, YouTube, LinkedIn), and [©2017 MQA. All Rights Reserved.](#) are located at the bottom right.

MQA vs. AIR

The vision behind MQA is to do no more damage to sound than travelling a short distance through air. By being able to resolve two sounds 8us apart – 15 times better than 192kHz – that vision has been realised. See how it compares below.

System end-to-end

- MQA
- Air with distance (metres)
 - 5
 - 10
 - 20

Amplitude

-10 0 10 20 30 40 50 60

μs

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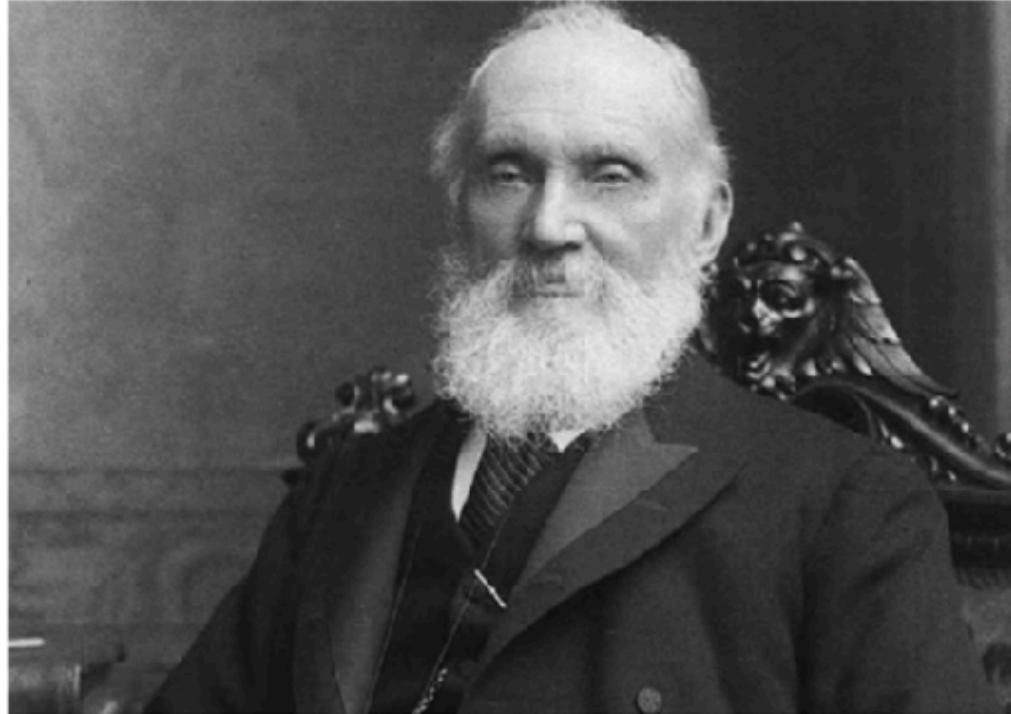
[!\[\]\(6fc807e4689b9a3fc846fc97f86cdb22_img.jpg\) Home](#) [Equipment Reports](#) [News](#) [Show Reports](#) [Blogs](#) [Buyer's Guides](#) [Back Issues](#) [Music](#)

[!\[\]\(37852462ad6b69a3f02caabab9f89b36_img.jpg\) Manufacturer Showcases](#)

Let the Revolution Begin
MQA and the Overthrow of 20th Century Audio

by [Robert Harley](#) | Sep 25th, 2017

Categories: [Digital-to-analog converters](#), [Music servers and computer audio](#), [Rock](#), [Jazz](#), [Classical](#)



“There is nothing new to be discovered in physics now. All that remains is more and more precise measurement.” — Lord Kelvin in 1900, five years before Einstein’s paper on relativity.

News


mark Levinson
HEAR YOUR FAVORITE MUSIC FOR THE FIRST TIME.
Introducing the N°519 Audio Player [DISCOVER MORE](#)

Featured Articles

- Zellaton Reference MkII Loudspeaker
- Five Questions For Alon Wolf
- Magico M6
- Magnepan 30.7 Loudspeaker, Part Two
- Magnepan 30.7 Loudspeaker, Part One


MUR AUDIO

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The term "paradigm shift" was coined by Thomas S. Kuhn in his influential 1962 book *The Structure of Scientific Revolutions*. According to Kuhn, a paradigm shift in the physical sciences occurs when a body of evidence accumulates that suggests the principles on which a scientific discipline is founded (the paradigm) is wrong, and a new paradigm replaces the old (the shift). Kuhn shows that this process unfolds in identical fashion throughout history no matter what the discipline.

Every scientific revolution, from the Copernican model supplanting Ptolemy's worldview, to relativity upending Newtonian physics, occurs in specific and defined phases. One of these phases is characterized by "crisis" in which a "battle" (Kuhn's terms) breaks out between followers of the old and new paradigms. The conflict arises because discoveries made within the existing paradigm don't quite fit that paradigm, yet the emerging paradigm is not yet accepted as scientific fact. Indeed, the emerging paradigm is often regarded as heresy.

Moreover, if you've spent your entire life adhering to a certain set of ideas, it's difficult to accept that your beliefs have been based on erroneous assumptions. You are simply too invested in the old paradigm. This resistance to new ideas is so entrenched that Kuhn suggests that a revolution is complete only when all the adherents of the old paradigm have died. He quotes Max Planck: "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."

Andrew Quint's Guest Editorial in this issue prompted me to revisit *The Structure of Scientific Revolutions* (I first read it in 1990), because Andrew's description of the controversy over MQA mirrors Kuhn's "crisis" phase of a scientific revolution. As Andrew describes, some commentators have staked out the position that PCM (or DSD) encoding is essentially perfect and therefore MQA is unnecessary at best and a fraud at worst. Unfortunately, the Internet has given voice to anyone with a keyboard, allowing individuals with absolutely no understanding of MQA's technology, and no firsthand listening experience, to weigh in, often with vitriolic invective. There are even some respected

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Audiophiles...? Audiofiles!



[MQA is Vaporware](#)

1

2

3

4

245 ►

By Rt66indierock, January 2

6,115 replies 253,132 views

computeraudiophile.com

Archimago's Musings

A 'more objective' take on audiophile topics among other thoughts... Twitter: @Archimago

Saturday, 15 July 2017

INTERNET BLIND TEST: MQA Core Decoding vs. Standard Hi-Res Audio



Introduction:

Well my friends, the time has come... Yes, it's another Internet Blind Test!

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► November 2017 (3)

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▼ September 2017 (5)

[MQA Core vs. Hi-Res Blind Test Part III: Subgroup ...](#)

[MQA Core vs. Hi-Res Blind Test Part II: Core Resul...](#)

[MQA Core vs. Hi-Res Blind Test Part I: Procedure](#)

[MUSINGS: Evidence of digital](#)

MQA – A CLEVER STEALTH-DRM-TROJAN

The screenshot shows a GitLab repository page for the project 'mqa'. The sidebar on the left includes links for Projects, Groups, Snippets, Help, Overview, Details, Activity, Cycle Analytics, Repository, Issues (0), Merge Requests (0), CI / CD, Wiki, Snippets, Members, and a Collapse sidebar button.

The main content area displays the repository details for 'mqa'. It features a large purple circular icon with a white letter 'M' and the text 'mqa' below it. Below this are buttons for Star (1), HTTPS, and a copy link. The repository statistics show Files (205 KB), Commits (16), Branch (1), and Tags (0).

The commit history table lists one commit:

Commit	Author	Date	Hash
add render filters	Mans Rullgard	committed 2 months ago	63f3864a

The file list table shows the following files and their last update times:

Name	Last commit	Last update
.gitignore	Initial revision	5 months ago
Makefile	Initial revision	5 months ago
bits.c	limit sync search length	3 months ago
bits.h	limit sync search length	3 months ago

At the bottom of the page is a link: <https://gitlab.com/mansr>.

MQA – A CLEVER STEALTH-DRM-TROJAN

Audiophiles...? Audiofiles!



Audiophiles...? Audiofiles!

In this context MQA now promises:

- Lossless Studio sound at home
- authenticated
- sound improvement via
- fixing “temporal blur” supposedly happening in AD/DA stage.



AGENDA

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34C3 MQA Part Anton

Christoph Engemann
Anton Schlesinger

30th of December 2017 in Leipzig

Anton's CD player

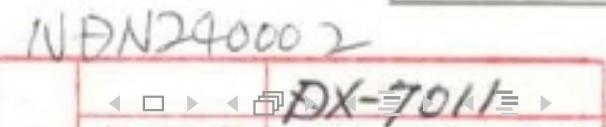
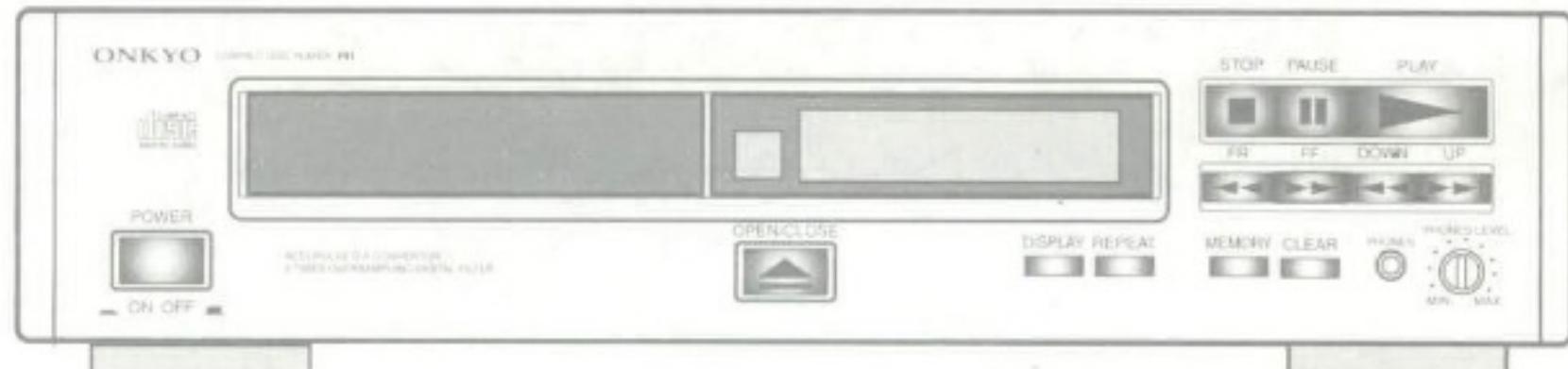
DX-7011

Compact Disc-Spieler

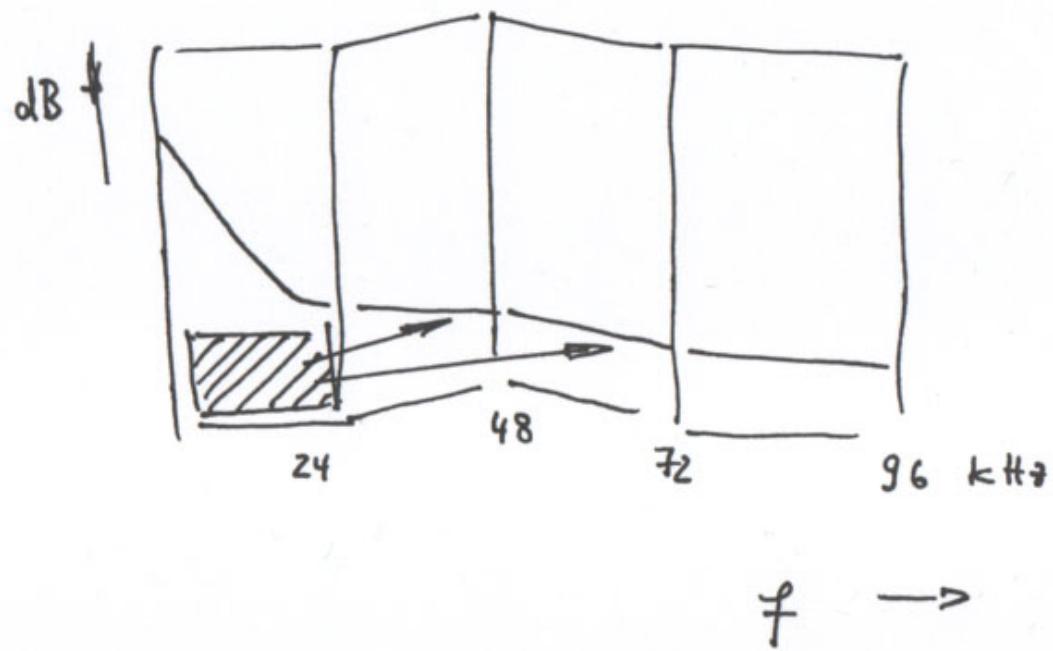
16 bit depth, 44.1 kHz sampling frequency

Flat frequency transfer ($\pm 0.3dB$ between 2 to 20 kHz)

A/D Conversion with 8 times Oversampling



Outline MQA audio technology



Original drawing at www.mqa.co.uk

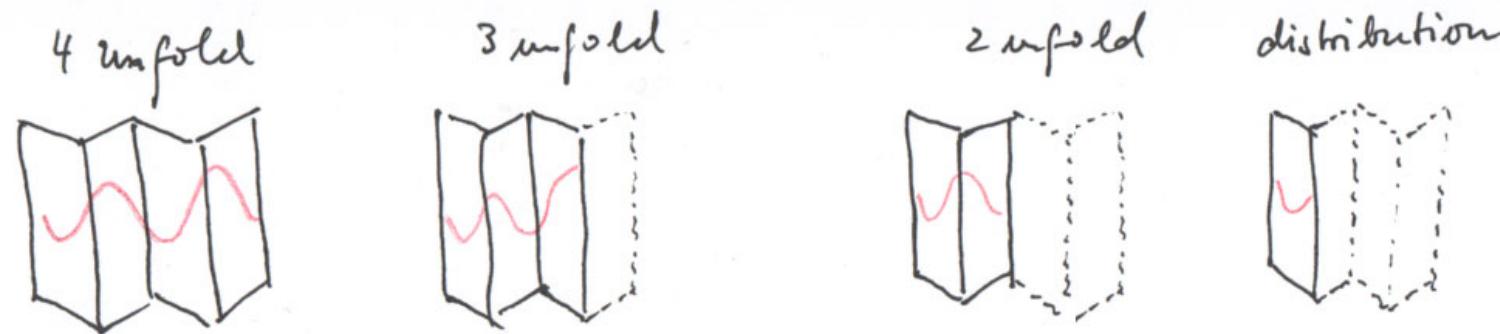
MQA is an encoder/decoder system for High Resolution (HR) audio that is nested in a container (ALAC, FLAC, WAV, etc.).

The entire audio chain needs new MQA-licensed hard- and software. The consumer, for example, needs an MQA enabled decoder to unfold the HR audio file.

The MQA compression scheme permits economical streaming of HR audio.

MQA shall be lossless and MQA shall improve audio quality.

Outline MQA audio technology



There are different quality versions for downloads; Original drawing at www.mqa.co.uk

Download prices of MQA are currently higher than for HR audio with 24 bit and 192 Hz sampling frequency (see on 2L);

The end user does not own the file, which is advertised as being the studio master. No changes of the stream are possible, no loudness normalization, no fading, no room compensation. Otherwise the MQA licence is terminated and audio quality falls below CD quality.

MQA claim

"We advocate lossless compression, lossless processing and hierarchical up/down-sampling; we highlight the quality and efficiency gains possible if the encoder and decoder are mutually aware and each matched to their analogue converters."¹

¹J. Robert Stuart and Peter Craven *A Hierarchical Approach to Archiving and Distribution*, presented at the 137th AES Convention, 2014, Los Angeles, USA



Is MQA lossless?

The data information rate for stereo noise (statistically independent samples and of equal probability) with 24 bit/192 kHz is at about 9 Mb/s. Based on the Shannon entropy H , the exploitation of probability allows for the calculation of max. redundancy R

$$H = - \sum_{i=1}^M p_i \log_2(p_i) \text{ [bit/amplitude value]}; R = \log_2(M) - H \text{ [bit/amplitude value]}^a.$$

For example, based on entropy optimization and FLAC compression, S. Hotto showed lossless compression rates of up to 40 - 50 % on HR audio material^b. It does not seem possible to achieve more than that because of low SNR at higher frequencies and the statistical (often noisy) nature of music.

MQA however offers a data reduction of 75 % by limiting the band width, lowering the bit depth and changing the amplitude and phase response. This is a lossy process and audio data at higher frequencies cannot be fully reconstructed (see S. Hotto's Hypthesis Paper).

^aWith M being the set of possible amplitude values and p being the probability i assigned to a value i

^bStephan Hotto / XiVero GmbH *Hypothesis Paper to support a deeper Technical Analysis of MQA (Master Quality Authenticated) by MQA Limited, 2017*

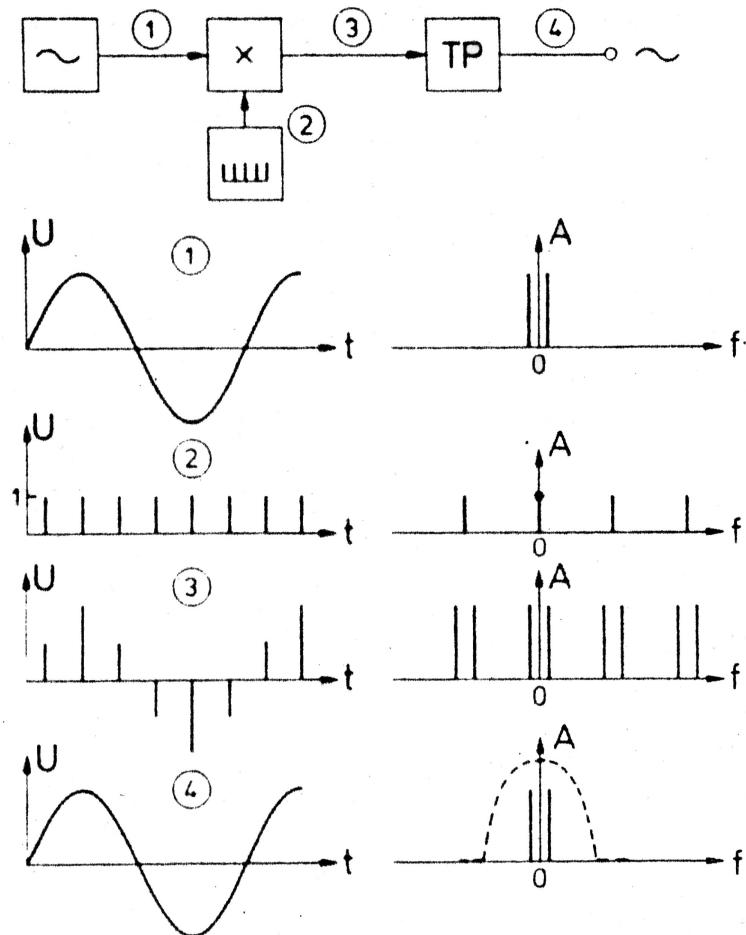
MQA claim

"[MQA approach of] re-coding results in superior sound and significant 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."²

²J. Robert Stuart and Peter Craven *A Hierarchical Approach to Archiving and Distribution*, presented at the 137th AES Convention, 2014, Los Angeles, USA



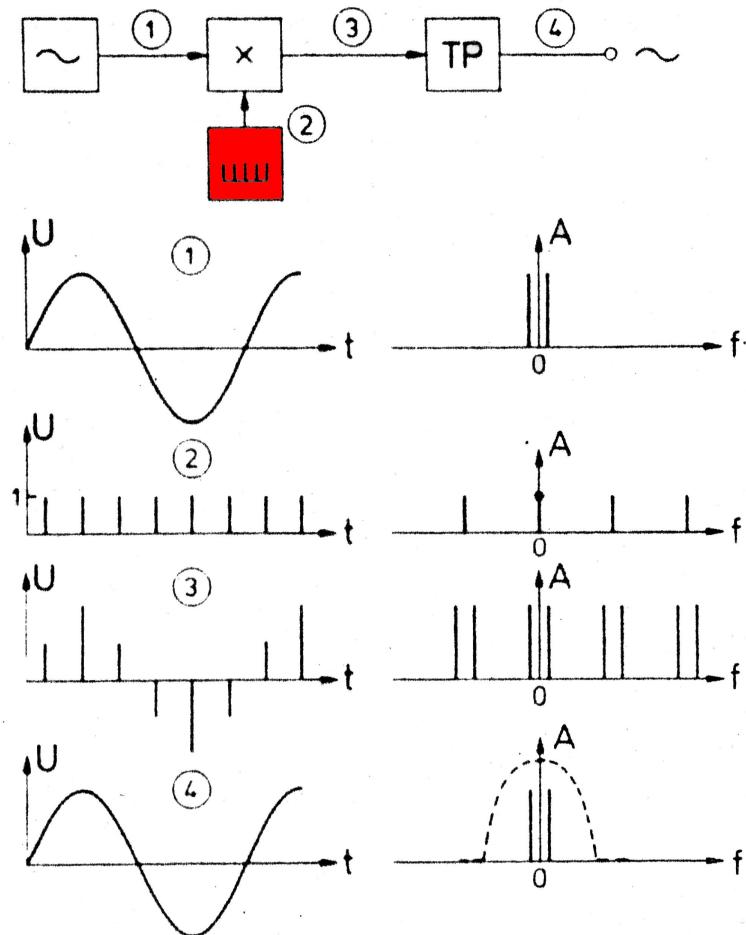
How aims MQA at improving sound quality?



Outline of the sampling process:

- 1 band limited analogue time function
- 2 series of pulses with sampling frequency at least twice the signal frequency (sampling theorem)
- 3 time discrete signal, where amplitude gets quantized with certain bit-depth, e.g. 24 bit per sample
- 4 analogue low pass filtered signal (TP) – it is (at 24 bit practically) equal the original signal, even between the time samples of the discrete signal

How aims MQA at improving sound quality?

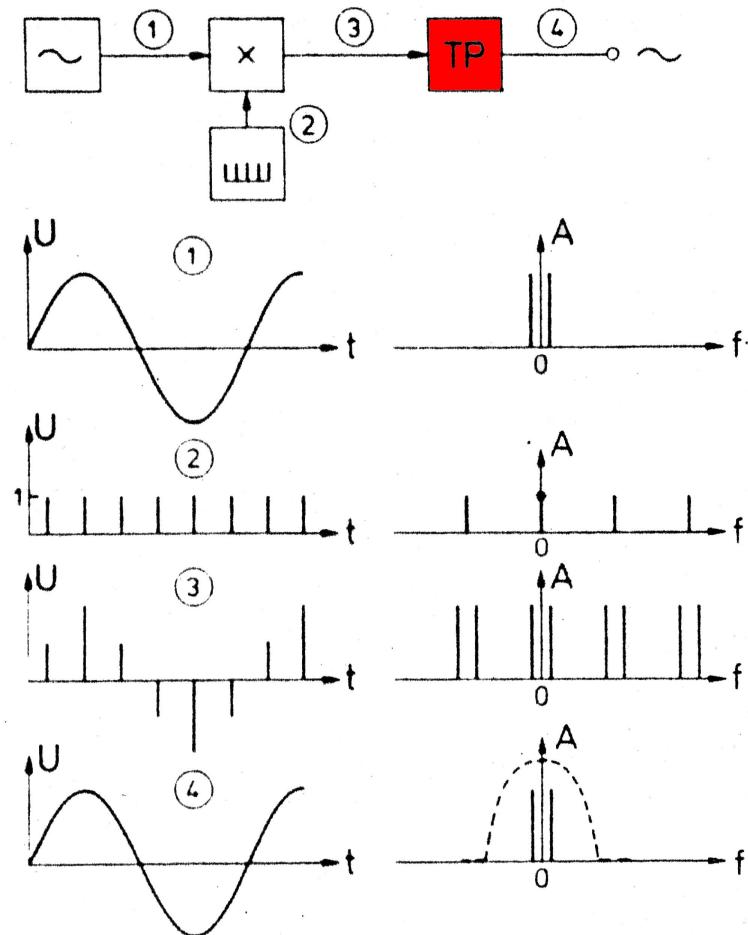


Instead of using a sinc-function, MQA employs a B-spline kernel for a sparse sampling scheme. This kernel shall improve the temporal resolution to allow for an auditory event detection of $10 \mu\text{s}$ in audio files for distribution and of $3 \mu\text{s}$ in audio files for archives. Moreover the MQA kernel offers “a wholly different time-frequency balance” and shall match to “the song (track)”.

For describing the temporal resolution of their system, Stuart and Craven propose to use a new metric called “temporal blur” instead of sampling frequency.

Stuart and Craven find it “intriguing that environment-derived kernels [in the auditory cortex] bear resemblance to some we [the authors] derive [for A/D and D/A conversion].”

How aims MQA at improving sound quality?



Avoid pre-ringing by using a minimum phase filter and apodization (windowing) instead of linear phase filters.

De-blurring / compensation of signal distortions during the recording process.

Is MQA improving sound quality?

In terms of listening experience: A recent blind listening test with 83 subjects revealed no preference. In some situations, standard HR audio was preferred.³

In terms of temporal resolution: Likely not, because an increase of the temporal resolution up to $10 \mu\text{s}$ (a bandwidth of 100 MHz) by “de-blurring” a base band signal with a sampling frequency of 48 kHz is at least questionable.

In terms of a new time frequency balance that is tuned to the song: There is no balance between the time and frequency representation of a filter; both are equivalent representations. If an adaptive filter is meant and implemented in MQA, a description of what is tuned to a song is needed.

In terms of minimum-phase filters to suppress pre-ringing: These filters however change the phase spectrum of the original recording. Hence they are not advisable for source coding. Linear phase filters are on the contrary without influence on the original signal (no audible pre-ringing), if these filters operate outside the spectrum of interest.

In terms of window functions (apodization) to suppress ringing further: S. Hotto shows that these filters avoid ringing at the price of increased aliasing and decreased temporal resolution in his *Hypothesis Paper to support a deeper Technical Analysis of MQA (Master Quality Authenticated)* by MQA Limited, 2017.

³<http://archimago.blogspot.de>

Do we need MQA enhancement based on today's evidence from neuroscience or media production?

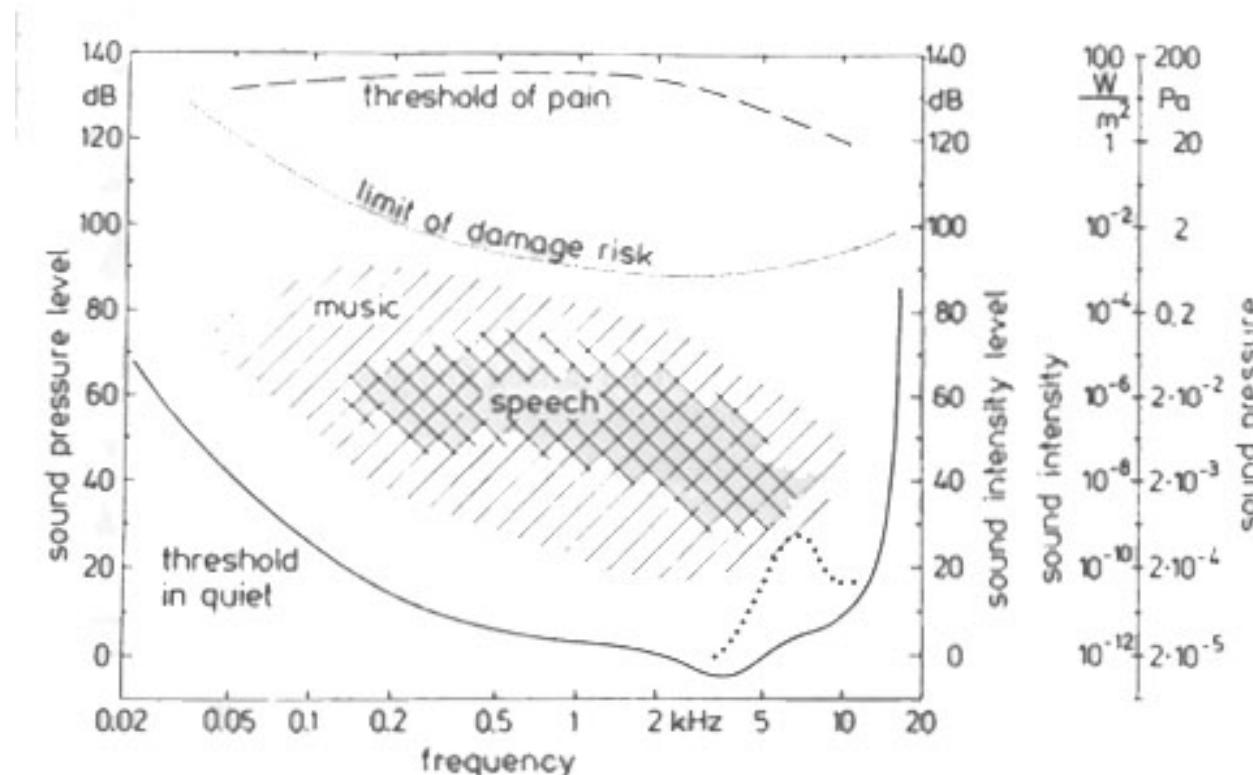
The requirements for a higher temporal resolution of MQA is corroborated with findings that binaural time differences are as low as $6 \mu\text{s}$.⁴ Indeed, for pure tones, humans are able to discriminate ITDs with just noticeable differences of $10 \mu\text{s}$. Those differences are however based on a central auditory comparison of sound waves at both ears. Because of the spatial Nyquist limit only the fine-structure of frequencies up to 1.3 kHz can be non-ambiguously analyzed.⁵

There is no need for an enhancement of audio from a scientific point of view as well as from an artistic point of view. The artistic concept with all variables (composition, performance practise, etc.) is captured on multichannel audio files. The transmission chain has always been kept free from influences ("the music is the message") and finally interpreted by the auditory system of the listener.

⁴J. Robert Stuart and Peter Craven *A Hierarchical Approach to Archiving and Distribution*, presented at the 137th AES Convention, 2014, Los Angeles, USA

⁵R. Stern et al. *Computational Auditory Scene Analysis: Principles, Algorithms and Applications*, chapter *Binaural sound localization*, IEEE Press/Wiley-Interscience, 2006.

Do we need HR audio based on today's evidence from neuroscience for listening to music?



Copied from E. Zwicker and H. Fastl
Psychoacoustics - Facts and Models, Springer, 1999

There is no data available that shows listening at frequencies above 20 kHz.

Music in general shows a $1/f$ amplitude spectrum that extends over the 20 kHz limen and results in faint sound intensities beyond 20 kHz.

The threshold in quiet towards higher frequencies increases with age or for people who frequently listen to very loud music (see dotted line in Figure).

Conclusion

There is no evidence-based research that supports the audio quality claims of MQA.

MQA is “lossy” because it reduces the bit-depth and the frequency response.

We hence see a degradation of audio quality (which – in its current version – might not always be audible). The algorithm of the MQA folding scheme is only vaguely described and its disadvantages for HR audio are obviously disguised by marketing slogans (“de-blurring”, etc).

Once a MQA infrastructure is established, the audio quality can be easily scaled down. MQA’s description of kernel optimization for each track (song) alludes to a perceptual coding scheme.

Conclusion

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Remember also:

There are free HR audio codecs that compress audio losslessly (FLAC, etc.).

Internet bandwidth is not a big concern in the western world anymore (on average 10 Mb/s) and will increase further. Hence no need for lossy coding of HR audio.

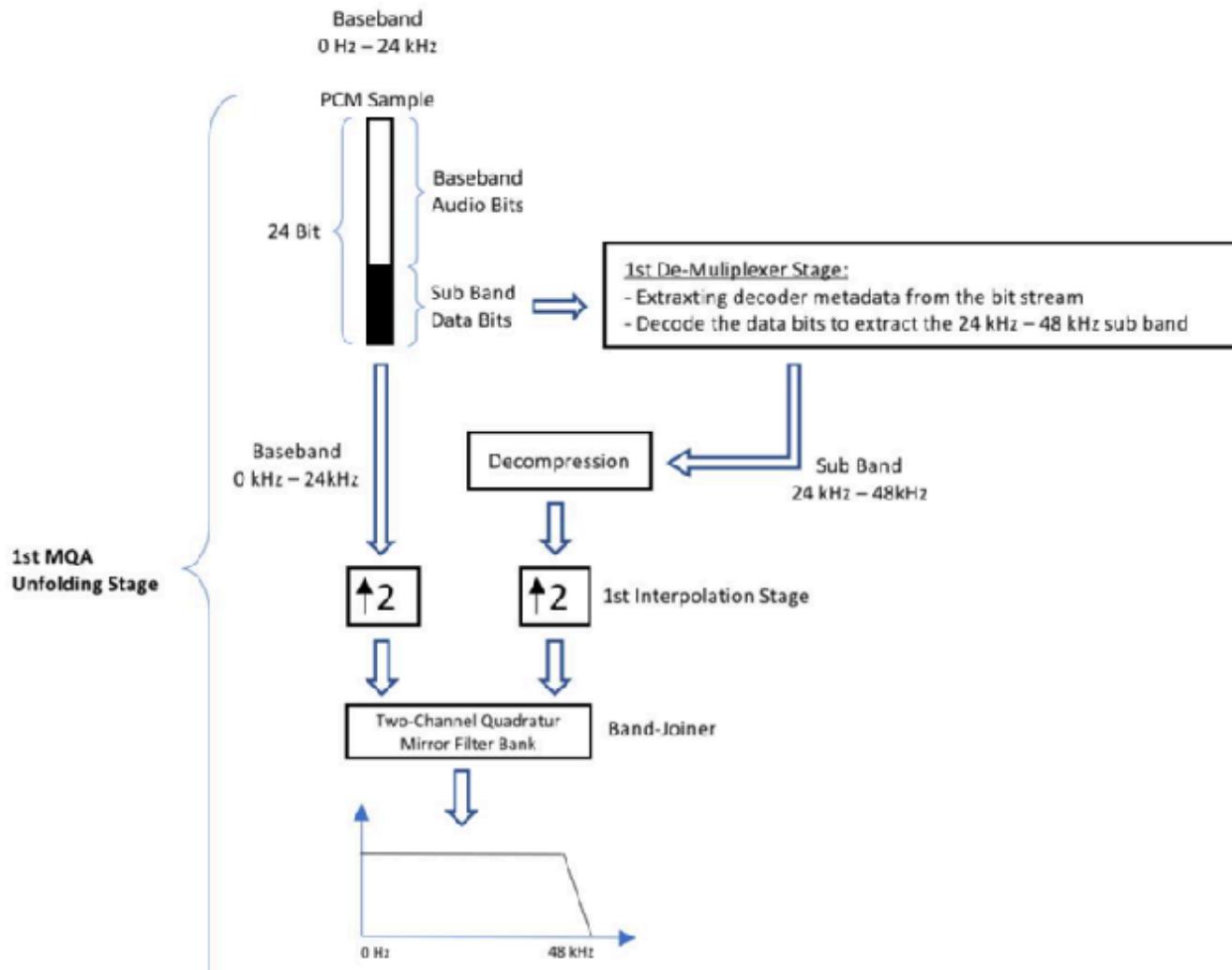
Most of the music is coded and stored in CD quality and has been recorded with selected equipment (generally not showing pre-ringing). Changing sample rates to HR audio, sometimes via analogue tapes, is a noisy process and usually driven by the aim of selling content again.

AGENDA

- ▶ 1. Audiophiles...? Audiofiles! (Christoph)
- ▶ 2. MQA claims examined (Anton)
- ▶ 3. 24bits: got some room to spare (Christoph)
- ▶ 4. Clever (Anton & Christoph)
- ▶ 5. Q&A

MQA – A CLEVER STEALTH-DRM-TROJAN

MQA – Hypothesis Paper



MQA – A CLEVER STEALTH-DRM-TROJAN

24Bits: got some room to spare

MQA – A CLEVER STEALTH-DRM-TROJAN

24Bits: got some room to spare

MQA: back to square one in digital audio

1981: CD: 16bits @44.1khz

2014: MQA: 15-17bits @48khz (some say 13bits)

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24Bits: got some room to spare

Authentication

Origin of data

Integrity of data

MQA – A CLEVER STEALTH-DRM-TROJAN



HOME

UNTERNEHMEN ▾

KARRIERE ▾

PRODUKTE

Utimaco Business Units

LIMS Produkte



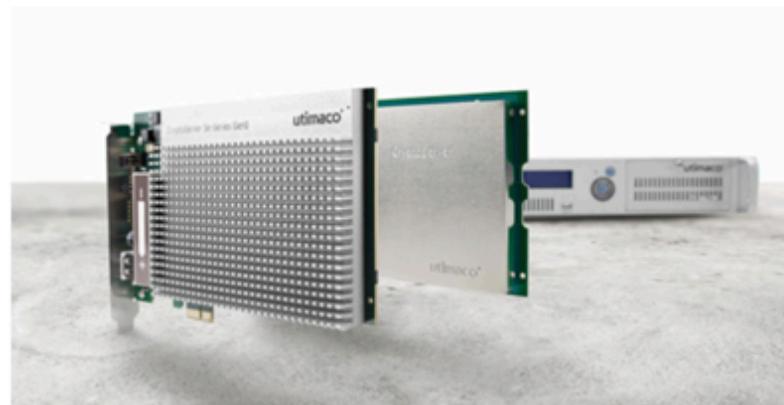
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MQA – A CLEVER STEALTH-DRM-TROJAN



Case study



Utimaco enables revolutionary step in digital sound quality and authenticity

The motivation: improving the user experience while authenticating the artist's work
MQA has chosen Utimaco to enable their revolutionary technology that delivers master quality audio in a file that is small enough to stream or download. MQA music guarantees the highest recording quality, as well as the provenance of the file. Utimaco's role was to provide the hardware backend – the root of trust – in which the cryptographic keys, which are used to sign MQA audio streams, are generated and stored.

The challenge: improving the listening experience without sacrificing convenience
A start-up with the highest credentials in quality audio production, MQA recently announced their Master Quality Authenticated (MQA) technology, an industry-first solution to capture and share high quality music. With traditional, compressed music files, sound quality has been continually sacrificed for convenience. With MQA technology, there is no sacrifice. MQA captures and preserves the missing 90 percent currently obscured or discarded in an MP3 file, and delivers it all in a file that is small enough to download and stream easily.

MQA – A CLEVER STEALTH-DRM-TROJAN

 CryptoServer Software Development Kit

 utimaco®

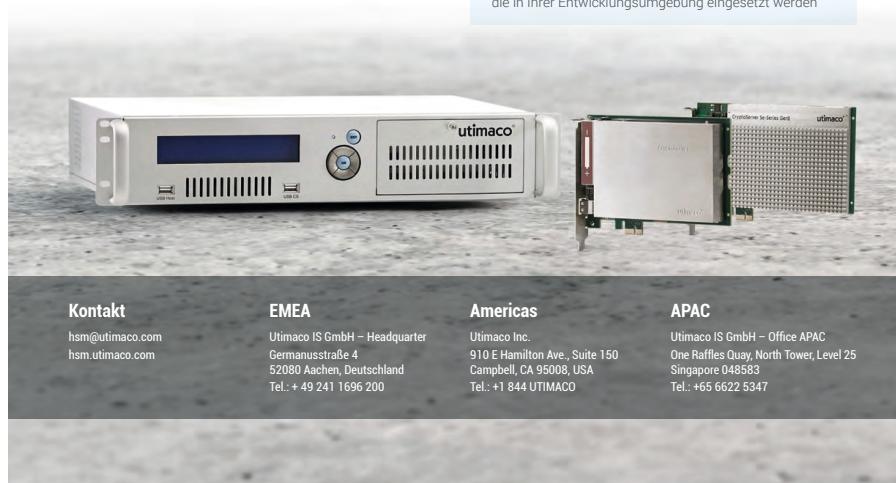


Die Entwicklungsumgebung zur Umsetzung Ihrer Sicherheitsanforderungen

Die Entwicklungsumgebung zur Implementierung von eigenen Firmware-Modulen, die innerhalb eines CryptoServer Hardware-Sicherheitsmoduls ausgeführt werden. Utimaco's CryptoServer SDK beinhaltet vollständigen Zugang zur Firmware, die zur Herstellung von Sicherheitsprodukten befähigt, die FIPS 140-2 Level 3 oder 4 erfordern.

Kostengünstige Entwicklung

- Keine zusätzlichen Lizenzgebühren für selbst erstellte Firmware
- Minimaler Trainingsaufwand durch die Verwendung von Standard-Programmiersprachen und einer einheitlichen Entwicklungsumgebung
- Vollständige Beschreibung der internen Programmierschnittstellen zur maximalen Nutzung der Basis-Firmware-Module
- Effizientes Testen und Debuggen mit Hilfe des CryptoServer Software-Simulators
- Reduzierter Preis für Hardware-Sicherheitsmodule, die in Ihrer Entwicklungsumgebung eingesetzt werden



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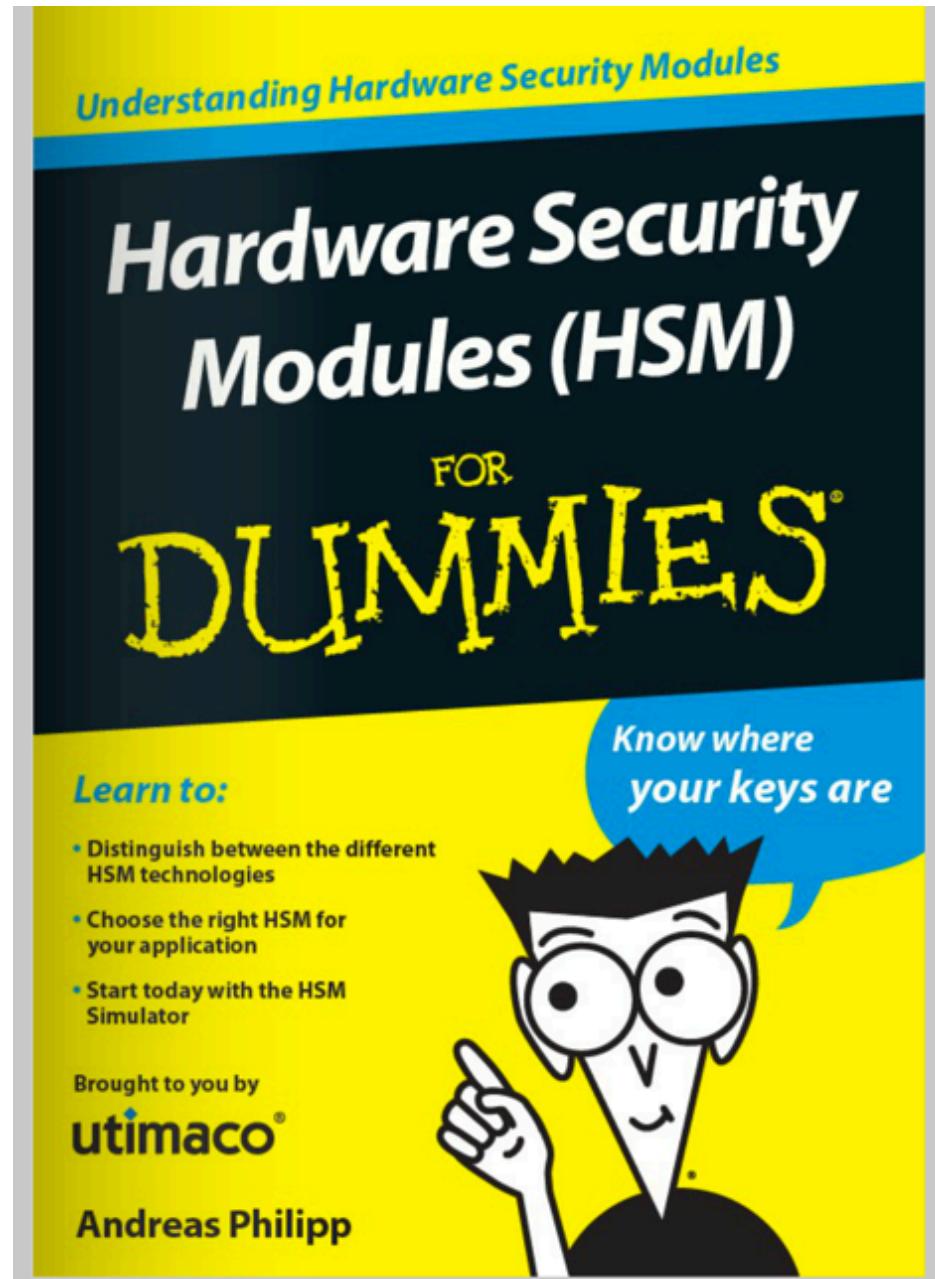
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24Bits: got some room to spare

Is this DRM?

MQA – A CLEVER STEALTH-DRM-TROJAN

24Bits: got some room to spare

DRM dilemmas

The issue of Digital Rights/Restrictions Management (DRM) is a sensitive subject with MQA Ltd; the company vehemently denies that its technology includes any such restrictions.

"MQA has no DRM component or application outside the studio," it says. "We have no opinion on this beyond noting that DRM is a futile exercise for general music distribution."

Andrew Harrison: MQA explained: Everything you need to know about high-res audio

[https://arstechnica.com/gadgets/2017/05/mqa-explained-everything-you-need-to-know-about-high-res-audio/?
comments=1](https://arstechnica.com/gadgets/2017/05/mqa-explained-everything-you-need-to-know-about-high-res-audio/?comments=1)

24Bits: got some room to spare

DRM

1. copy protection is just one form of DRM

The goal of DRM is to manage the rights of a user with data.

Both in the sense of restrictive and permissive uses

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24Bits: got some room to spare

DRM

1. copy protection is just one form of DRM

MQA permits: copying

MQA restricts: access to parts of the file

24Bits: got some room to spare

DRM

1. copy protection is just one form of DRM

MQA restricts: access to parts of the file

Conditional access

Access granted if payed for MQA-capable DAC

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DRM

MQA = Freemium Model

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24Bits: got some room to spare

DRM

2. MQA firmware contains provisions for copy-protection

**Salsa20 cipher
bit transposition**

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24Bits: got some room to spare

DRM

"The streaming services have a bad situation, there's no margins, they're not making any money," he said. "Amazon sells Prime; Apple sells telephones and iPads; Spotify, they're going to have to figure out a way to get that audience to buy something else (...)"

Colin Stutz: Jimmy Iovine Breaks Down What's Wrong With the Music Business, Warns Against Overoptimism in Streaming: 'They're Not Making Money' - <https://www.billboard.com/articles/business/8053937/jimmy-iovine-interview-whats-wrong-music-streaming-defiant-ones>

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24Bits: got some room to spare



MQA – A CLEVER STEALTH-DRM-TROJAN

24Bits: got some room to spare

DRM

MQA licensing reach:

Recording Software / Plugins

Recording / Mastering Studios need to acquire certified equipment

Artist: back catalogues remastered

Download / Streaming services

CD / DVD physical media manufacturers

Hi-fi manufacturers / software developers

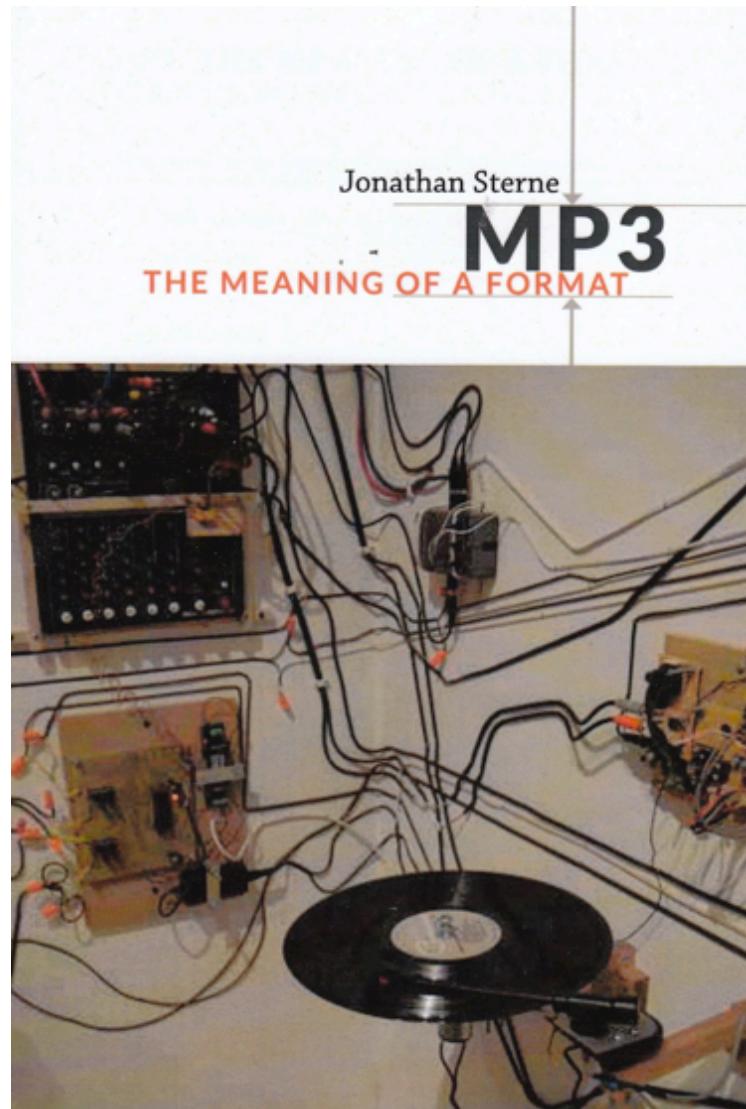
End customers

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MQA – A CLEVER STEALTH-DRM-TROJAN

Clever



MQA – A CLEVER STEALTH-DRM-TROJAN

Clever

“Audiophiles experience tweaking as creativity”

“Audiophiles are always excited about something”

Brian Lucey

MQA – A CLEVER STEALTH-DRM-TROJAN

Clever

Clever & Stealth?

MQA Open Questions

MQA-middle-man position effect on industry

IP control of Audio-Hardware and Software

User tracking - privacy provisions

Key-management if MQA goes bust?

FOSS tools and toolchains for music production, consumption

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Thank you

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anton.schlesinger@studio-singer.de

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Ressources

Xivero Whitepaper on MQA

<https://www.xivero.com/de/hypothesis-paper-to-support-a-deeper-technical-analysis-of-mqa-by-mqa-limited/>

Archimago Blog (MQA listening test)

<http://archimago.blogspot.de>

Mans Rullgard (MQA filter coefficients / control stream)

<https://code.videolan.org/mansr/mqa>

Linn (hifi manufacturer) criticsm of MQA

<https://www.linn.co.uk/blog/mqa-is-bad-for-music>

MQA: the missing link

Why is there no MQA-cable?

Let's design one!

Please offer suggestions after the talk or via email

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