"I HAVE TO SAY THAT SEEING THE DIFFERENCE IN MEDIA PROCESSING BETWEEN SEASONS 1 AND 2, WHEN HDE BECAME WIDELY AVAILABLE, WAS FANTASTIC"

DISNEY

CODEX

Eternal sunshine of
the lossless Codex

In early November 2020, Zerb Managing Editor **Rob Emmanuel** met up – virtually – with **Brian Gaffney**, VP of Business Development at CODEX, an X2X Media company, to discuss the company's latest award-winning innovation in production workflows.

During this last month, whilst speaking with the folks prepping new projects at various camera rental facilities and post-production partners around the globe, I've started to get the feeling that the production world is finally getting back to work. This is all good news after eight months of 'working from home' during the pandemic.

However, as we come back to work safely, it will become clear that things really are different now. Word is that costs below the line are up by 20–25% due to new procedures that have been put in place to help protect production teams from, as well as mitigate against, the effects of the COVID-19 virus. Productions have needed to contract new IT staff to set up remote networks; and extra production assistants and personnel have been engaged specifically to enforce new safe working duties, such as handing out masks and ensuring all crew rigorously adhere to social distancing at all times. All of these newly adopted processes and policies have increased the costs on already budget-challenged productions.

Necessity is the mother of invention

These cost increases have been seen across the industry, from cinema production to sports broadcast operations. In turn, engineering ingenuity and various new technologies that had previously been on the edge of coming to market have now been fully integrated into the production process, from IP-based camera control and virtual sets, to the remote reviewing of dailies. One of the new technologies that has been adopted in full force is CODEX High Density Encoding (HDE) in support of ARRIRAW image files.

The ARRI ALEXA camera system is widely used in both streaming television and cinema production. Its capability to record an uncompressed image in large format with the quality of film has made it an award-winning choice for many cinematographers; in 2019, Sir Roger Deakins used the new ARRI ALEXA Mini LF on *1917*. In fact, most of the Academy Award-winning features from the last 10 years have been originated either on film using an ARRI camera or in the ARRIRAW format from an ALEXA. With the ALEXA, you have the choice to record in one of two formats: uncompressed ARRIRAW or compressed ProRes. In the ProRes format, the camera generates lovely images which, because they're compressed, are created at a file size that can be half the size of ARRIRAW images. That smaller data footprint means a welcome reduction in associated storage costs, so it's hardly surprising that most streaming television productions have adopted ProRes as the camera 'negative' format of choice. The reality is that, except for a select few high-budget, heavily VFX-produced series, most TV shows cannot afford a RAW workflow.

Above: The ALEV III (A2X) CMOS 4.5K sensor of the ARRI ALEXA LF
Left: DIT Eduardo Eguia offers some insight into how HDE enhanced his workflow on Disney's *The Mandalorian*
Inset: The ALEXA Mini LF with Compact Drive

Then along comes High Density Encoding

So, what if you could enjoy the benefits of the uncompressed ARRIRAW file, and all of the data associated with its images, whilst achieving a data footprint about the same size as that of the equivalent footage shot in the compressed ProRes format? Well, with HDE you can do just that.

The recording engine for the ALEXA was designed and provided to ARRI by CODEX, and the company supplies the recording media, too. That recording solution and media combination earned CODEX an engineering EMMY in 2018 and the company was honoured to once again receive the Television Academy's prestigious award in 2020, on that occasion in recognition for its RAW workflow with HDE.

One of the challenges with designing recording solutions is that the camera manufacturers are racing to build large image sensors into smaller camera bodies. Consequently, CODEX needed to enable a large-format, high frame rate, uncompressed file to be recorded, but in a way that it can still be wrapped up in-camera as an ARRIRAW (.ARI) file, regardless of whether the camera is large or small. The really demanding part, as the camera bodies get smaller, is that manufacturers sacrifice processing power within the camera, in their effort to reduce the camera's overall weight and physical size while still meeting all the creative demands of the cinematographer. As a result, the Bayer pattern file that is created can be slightly less efficient than it would be if more processing power had been available.

In an effort to preserve RAW recording as the ultimate digital negative format and to make RAW available not only to cinema productions but streaming television as well, CODEX developed a reordering schema whereby the file size of the original .ARI file can be reduced by 40–50%.
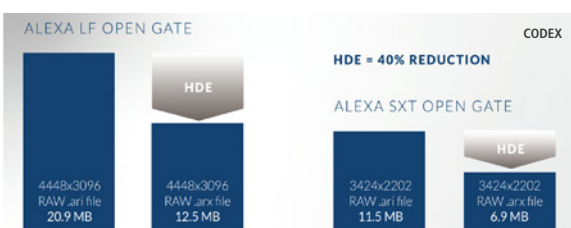
Examples of the reduction in file size that HDE can provide

> " The really demanding part, as the camera bodies get smaller, is that manufacturers sacrifice processing power within the camera, in their effort to reduce the camera's overall weight and physical size.
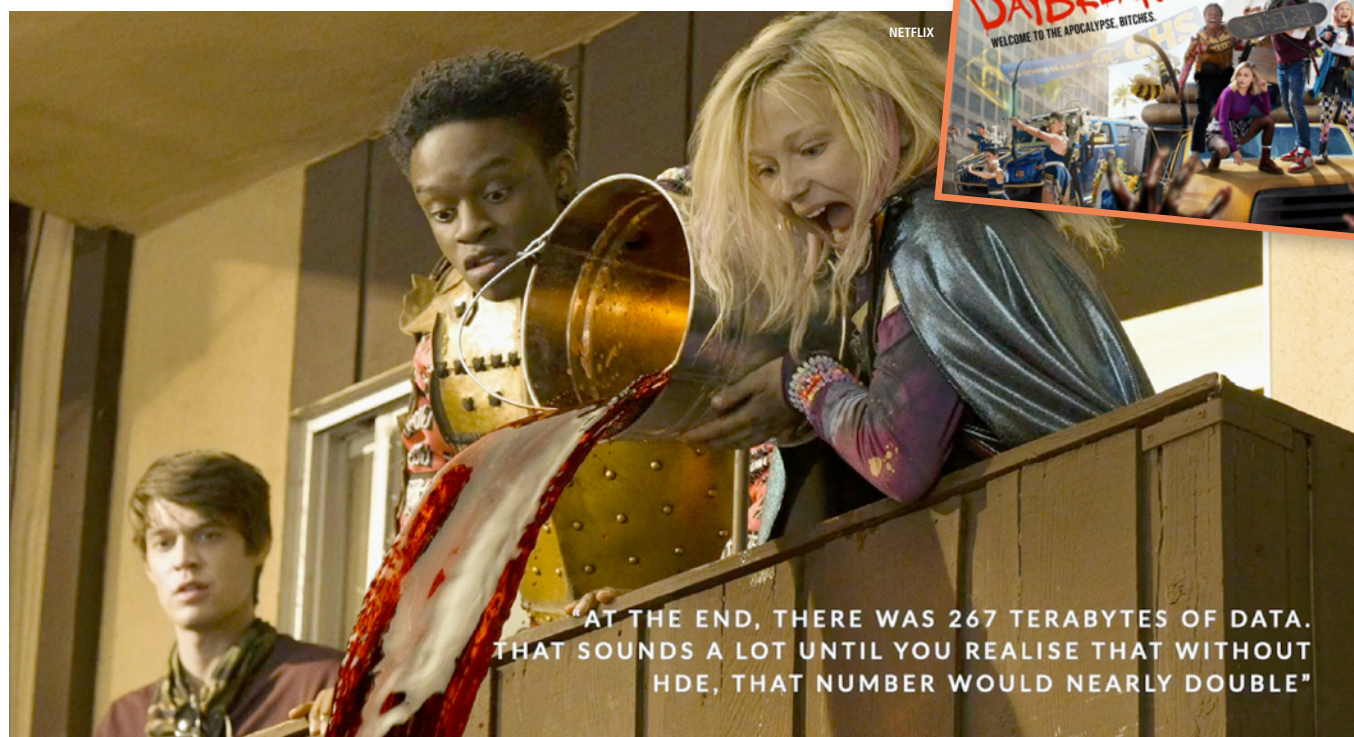
How does it really work?

The HDE process is not compression; it doesn't create a new file with a new transform as happens when creating a ProRes file from the ARRIRAW files. HDE simply, as it copies across the raw data files, repacks the Bayer pattern file in such a way that the amount of data can be reduced while still retaining all the original file structure and metadata information. It is bit-exact and 100% lossless.

When you run a checksum verification process on the original media to prove the integrity of the data, it's commonly referred to as an md5 checksum verification. Digital imaging technicians (DITs) and data loaders do this routinely when backing up and offloading media for post. With HDE, you can run an md5 checksum on the original data, then encode the files with CODEX Device Manager software. In doing this, the files are automatically renamed by changing their extension from .ARI to .ARX, to notate that they have been encoded. Then, were you to decode these .ARX files back to the original .ARI file, the md5 verification hash codes would match.

An illustration of the relative costs incurred when storing ARRIRAW files compared to the equivalent HDE encoded files, which demonstrates the savings that can be made

CODEX has automated this encoding process with its Device Manager software, which is a licence-free solution that's downloadable from the CODEX website, and has also published a software decoding kit (SDK) to provide free of charge to the industry. This is supported by more than 30 leading commercial post-production applications, such as BMD's DaVinci Resolve, FilmLight's Baselight, Colorfront's Transkoder, Autodesk Flame, Foundry's Nuke, and many other third-party applications. Not only does HDE reduce the file size by almost 2:1, it speeds up the workflow because data transfers, VFX turnovers and processing dailies can all be done near enough twice as fast because the files are that much smaller. This means line producers and unit production managers can realise savings in storage from production through to post, and even on their long-term archiving to LTO (Linear Tape Open, a high capacity reel tape storage solution) or the Cloud.

Efficient workflow with High Density Encoding

> "AT THE END, THERE WAS 267 TERABYTES OF DATA. THAT SOUNDS A LOT UNTIL YOU REALISE THAT WITHOUT HDE, THAT NUMBER WOULD NEARLY DOUBLE"

HDE considerably reduced the file size of all the material shot for *Daybreak*, Netflix's post-apocalyptic black comedy series

> "
>
> Not only does HDE reduce the file size by almost 2:1, it speeds up the workflow because data transfers, VFX turnovers and processing dailies can all be done near enough twice as fast because the files are that much smaller.

In May 2020, during the pandemic, CODEX successfully published a SMPTE registered disclosure document (RDD) detailing High Density Encoding. This RDD 51:2020 has allowed the studios and streaming networks to embrace HDE. Having a documented description of the decoding process provides anyone with the ability to create commercial applications that will be able to open and access .ARX files now and in the future. This has reassuringly provided confidence to the studios and networks when archiving their HDE-formatted files that they really are preserving the full integrity of the original 'negative'.

Finally, with everyone needing to be far more environmentally conscious in all aspects of workflows, it's important to highlight that, with HDE, the long-term storage of material in the cloud is now greener. With files taking up almost 50% less space on storage drives, energy consumption is dramatically reduced, which is great for the planet. With High Density Encoding, less really is more!

On the facing page are some quotes from those who have had firsthand experience of working with HDE. They are extracts from a couple of production case studies that demonstrate how productions have embraced HDE; please follow the links to read the articles in full.

HOW TO ENCODE ARRIRAW HDE
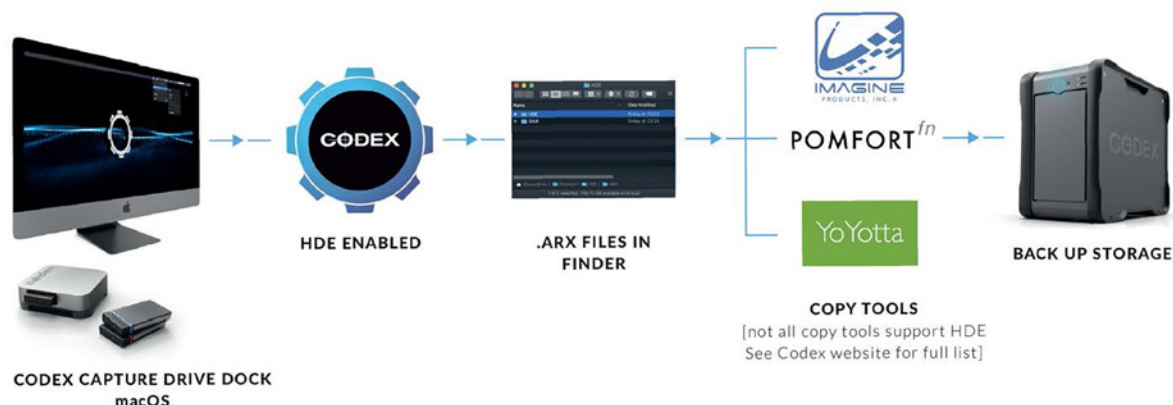
An illustration of the workflow stages involved in encoding ARRIRAW files to HDE

The Thunderbolt 3 Compact Drive Dock and Compact Drives from CODEX

Eduardo Eguia was the DIT on Disney's *The Mandalorian*. He fully appreciates how: "*HDE helped the workflow tremendously, not only to speed up the process of managing the media but by improving the turnaround time to get the CODEX capture drives back to the Camera department for reuse.*" (https://x2x.media/dit/DIT-Eduardo-Eguia-details-the-imaging-process-on-The-Mandalorian)

The shoot for Netflix's *Daybreak* took 87 days to film all 10 episodes and was supported by the team at Fotokem post-production. Fotokem's head of software engineering, Freddy Goeske, explains: "*The filmmakers wanted to shoot about four hours a day on the [ALEXA] LF, which in Open Gate results in about 1.8 terabytes of data per hour. That's pretty big. At the same time, they needed to keep the budget more in line with an ARRI SXT show, a classic RAW scenario… X2X spent a lot of effort building HDE. We were able to integrate it seamlessly into our nextLAB system, and build that into our dailies software platform so that the data could be ingested from the CODEX camera mag. We had one person doing color and all the dailies work, so it was important that this person be able to go about their day and not even think about it. The High Density Encoding had to happen on the fly, without reducing the speed of the process. And the net effect was the reduction of the data footprint by about 45%.*" (https://x2x.media/case-studies/X2X-FotoKem-Deliver-Efficiency-with-HDE)

Fact File

Brian Gaffney is VP of Business Development at CODEX. Both CODEX and PIX are entertainment technology companies that partner with clients to enable creative flow across the production life cycle with a suite of secure communication and content management solutions. Their award-winning products for the media and entertainment industries include production solutions as well as high-performance recording and workflow tools in support of the leading camera vendors for feature, television and commercial production. They also provide a personalised service in the rapidly evolving production landscape. They ensure creative continuity and reduced project risk by ensuring that ideas are accurately shared, stored and preserved throughout the entire creative process. Designed for filmmakers by filmmakers.

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