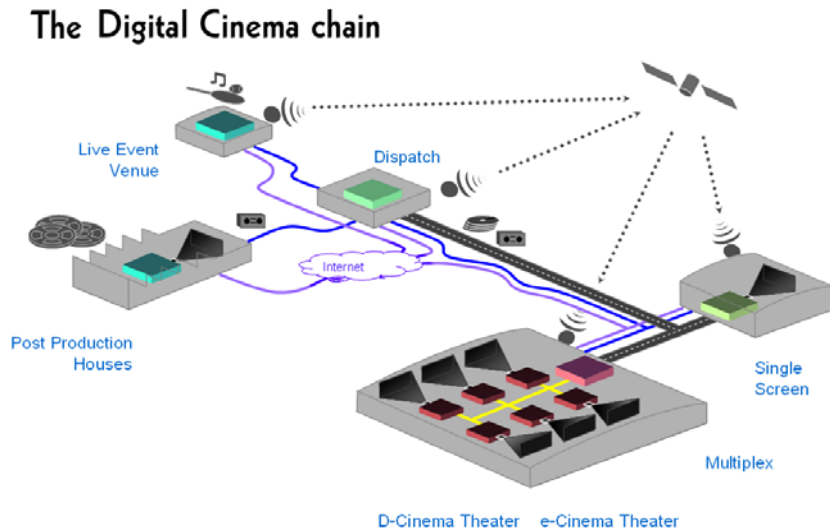


By: Benoit MICHEL, New Technologies Advisor, EVS Digital Cinema (Belgium)

Digital Cinema Key Questions

Will digital cinema create more revenues? Is digital cinema quality good enough? What is this '2K vs 4K' controversy? Will it be more complicated to use than a 35mm system? Will it attract more customers and pay for the cost difference? ...these along with many more questions were asked during the digital cinema special sessions held during the large cinema conferences in the last five

years. As solutions are starting to appear with commercial deployment as a backing, everyone continues to ask the same fundamental questions. But the first one should be "What is digital cinema?" The naive answer is "some kind of large TV projector connected to a big PC with movies recorded on hard disks". This is both true and completely false.



Global thinking

Let's first step back for a global approach: digital cinema is above all a concept, a complete system, covering the entire movie production chain from the acquisition with digital cameras to post-production to distribution to exhibition, all with bits and bytes instead of 35mm reels. The distribution and exhibition parts of the concept are highlighted in the figure above showing production sites, distribution servers and exhibition set-ups for various kinds of theaters. Each of these functions needs specific equipment. The post houses require very large storage to be able to create the various versions with different soundtracks, subtitles and PG ratings. The distributor will package together one or more of these versions for their customers and send them through satellite links, boxes of DVDs or magnetic tapes. The exhibitors have a large range of requirements for small 50 seat rooms to large 80 feet wide screens. All the square boxes in the figure are interconnected (or networked) computers but the hardware, software, storage size and CPU power are completely different from one location to the other. The only way to optimize this digital cinema network is to think globally while acting locally to optimize each node in the chain.

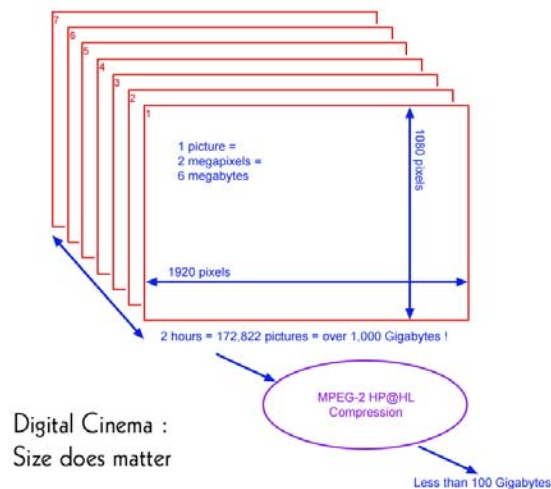
Bytes and pixels

We will now focus on the last node, corresponding to all our theatres. This theatre has two basic components: a server and a projector. The server receives and stores the digital movie content by one of the ways mentioned above and sends the content to the projector at request. This brings up the first set of questions: What about compression, quality and that '2K/4K' problem? Let's first work out some math: a 2 hour movie has 2 hours x 3600 sec x 24 frame/sec, thus the server stores 172,800 images. For the 2K images, we have exactly

1920x1080 pixels or 2 megapixels in each picture. As each pixel contains three bytes of information, our whole movie weighs in at $3 \times 1920 \times 1080 \times 172,800$ bytes. That is 1,069,805,000,000 bytes, more than 1,000 gigabytes! Thus we would need at least a dozen large hard disks to store only one movie. But this calculation assumes uncompressed data. Obviously, some compression is needed to keep the storage and transmission costs down. The ideal compression should be:

- Visually lossless: keep the quality as high as possible with no visible difference from the original
- Standardized and interoperable between manufacturers on a worldwide basis
- Easy to use on both compression and decompression sides.

Fortunately, the MPEG-2 compression scheme already used in digital TV and DVDs is doing quite well on all those fronts. There were many comparisons made between original content and high bitrate MPEG2 (DC uses the HP@HL variant): The result - no one was able to distinguish the difference, even some 'Golden Eyes' from the major studios. Our movie is reduced to 80 gigabytes instead of 1,000, less than 10% of the original size. This allows a standard exhibition server to hold at least two full length features in addition to many ads and trailers.



4K vs. 2K


Should the 4K picture not be far better than this dull 2K picture you have now? This is the big question raised in Hollywood these days. What is strange is that the answer is 'No'. Let's explain: if you sit at three screen heights from the screen base and look carefully at a very sharp digital image in ideal conditions, you will not be able to sort one pixel from the other. It is not the projector's limitation or the electronics; it is just that your eyes have reached their limit resolution. This is true if the image is 2K (1920 pixels along the width of the screen) and is even greater if it is 4K (4096 pixels). Therefore, in order to benefit from the added resolution of a true 4k picture, you need to sit in the very front row or even a little closer to be safe. But, in this case, your vision angle, which is around 60°, will intercept only half of the screen at a time. And what will you see? Half of the pixels, something like 2000.... The true question is thus "Why should we pay an unknown –but presumably high- price or wait five to ten years for these 4K pictures from which we will never truly benefit?"

To be or not to be a digital cinema pioneer?

The last question we will review: Why should I go digital? ? The goal is "to make profits", but how? "Make the difference" is the motto of all successful marketing strategies. In order to make the difference, your theatre needs to shine more than your competitors. Attracting the audience and making the customers happy so that they will come back again and again is not an easy challenge. What could attract them more than a new versatile room with pristine

quality digital movies, concerts, political and sporting events in high definition and in real time? Digital cinema is not only a way to suppress reel handling in the booth, it is also a source of additional revenues with the flexible scheduling that allows for last minute changes, the local advertisements and the various alternative contents from David Bowie concerts to Sumo, Formula 1 and the Olympics...

Glossary

2K	K stands for 1000. 2K is the typical size of the best DC actual resolution in production = 1920 or 2048 pixels width x 1080 pixels height.
4K	Possibly a future generation of DC top end projectors with a resolution of 4096 pixels width x 2160 pixels height.
BITRATE	number of data bits transmitted per second. The larger the bitrate, the better the quality (and the storage and transmission costs!).
DC	Digital Cinema, cinema stored and projected digitally. E-Cinema is the lower-grade variant of DC.
 H.264	Compression method used to reduce moving image size. Heavily counting on the fact that two images in a sequence are quite close, it doesn't transmit the part of the image that can be taken from the previous one. Quality may vary and is related to the compression ratio and thus to bitrate.
SERVER	A dedicated computer able to record and replay at high throughput the bytes stored in his very large hard disk memory. The storage capacity of servers range from 3 to 12 hours typically with some large versions up to 36 hours.