



## An overview of the digital cinema future

A revolution that is also an evolution (and vice-versa)

You already know many advantages of digital cinema : no more needs to duplicate and distribute physically thousands of reels each year, no more heavy reels to move and assemble each week, a consistent high quality from the first show to the last one, rock solid images with no jitter and luminosity 'pumping' effects and perfect sound reproduction.

"Maximize your ROI" is the current buzzword in so many industries. Digital cinema is not different ! Live events, special screenings, the ability to increase the number of screens to playback without an additional physical print, and the additional insertion of locally produced advertising... will all make the difference.

The two big ways to make money are : increase revenues and decrease costs.

The last one is not expected to occur this year. Early adopters of any new technology had to pay the premium price - or to be very clever and invest themselves in some kind of testing campaign. But everybody is sure that Digital Cinema will follow the same cost decrease curve as the TV sets, computers and other CD players have followed over time.

But the various ways to increase revenues are available immediately. They can be sorted in a few big categories : simplicity, versatility and security.

### **Simplicity**

Various steps in the motion picture industry chain will disappear with the emergence of digital cinema : film duplication, physical distribution and assembly of the reels and so on. The duplication cost of at least \$1,300 per movie will be replaced by a few dollars worth of digital transmission.

The sound chain will also be more simple : the digital pipe from the studio to the theatre is wide enough to accommodate not only the picture but also a full 8 or 12 channels of sound without any compression needed. The related cost of competing digital audio format sound decompressors in the theaters may thus be completely avoided.

### **Versatility**

An unsuspected blockbuster like 'Blair Witch Project' is probably as frustrating as the 1969 movie 'Astro-Zombies' but not for the same reasons. You have lots of customers waiting in lines and only one 35mm print of the marvelous gem. What do you do? In a digital world, you press two buttons, cancel a few mostly unattended shows and replace them with the very same digital file projected as the one on your main screen.

Why not attract local viewers for a special single screening of the movie featuring the new mayor of your small town ? Yes, at the beginning of his career, he was a movie actor. Why not, even US presidents were actors... In a digital world, having a copy for a single screening cost almost nothing.

The creation of an original Digital Cinema Master may cost US\$25K to 100K. There would be the cost of transmission also. This is compared to the creation of a typical large 35mm print order of 2,000 prints @ US\$1300.00/print for a total of US\$2,600,000. This cost doesn't include shipping, insurance and the projectionist labor to assemble it on a platter and then move it from theatre to theatre.

Indianapolis 500 or Monaco's Grand-prix on a fifty feet wide screen should attract lots of motor sport fans. It would be a better experience than what they get watching the race at home, even on a 60" Home Theatre system. In a digital world, this can be projected as a LIVE event, not two weeks later when nobody is interested anymore.

All those arguments and many others were developed years ago by a small New-York company known as 'The Screening room, Inc.' This pioneering company is the typical early adopter and was able to survive - and more - even with the premium prices they surely had to pay for lots of their equipment.

Other companies that are realizing the potential of "alternate content" are: Emerging Cinema, Madstone Networks, National Screen Network, and In Theatre Entertainment.

## **Standards**

Avoid at all price the mess caused by various incompatible systems ! Just think of the problems you have in a computer network with PCs and Macs connected together or remember the bitter experiences with the four proprietary sound standards that exhibitor have to manage everyday. Standardization of digital cinema will occur but this is a long and painful process. Standards groups like SMPTE and MPEG are working hard but extracting a consensus from large groups like those ones takes many years and nothing is expected before at least two years.

EVS, like many other server and projector makers, is looking for short-term interoperability while keeping an eye wide open in the standard committee's direction. Interoperability tests have been done in all countries by every company involved in the Digital Cinema industry because everybody sees the interest to keep the cinema equipment as useable as 35mm film.

Standards will also allow a smooth evolution over time. Digital Cinema equipment will certainly be enhanced following a curve more or less parallel to the one in the IT industry. Like Moore's Law: "Processor speed will double every 18 months" storage will become smaller, cheaper and faster. These changes will make Digital Cinema more cost effective with each year. Following established standards is the only way to ensure a smooth transition through the evolutionary steps that will inevitably occur.

## **MPEG**

MPEG is part of the most recognized standards and is now adopted worldwide in the TV broadcast industry. At first, MPEG-1 was a compression scheme with just enough quality to compete with standard NTSC. But a more clever and more versatile standard was introduced and has become an instant worldwide hit. Named MPEG-2, it covers a lot of different flavors and bit rates of the same compression scheme. For digital cinema, the high-end variations of this standard guarantees a very high quality at the exact same high resolution as the digital projectors in use now. On top of that, consider that MPEG-2 remains open to even higher resolutions than what is in use today. This openness and the worldwide success of MPEG-2 are a potential guarantee of long term usability.

You may think that standardization committee are slow to produce there paperwork and you are true! But once it is adopted, it opens a path for the future that will roll out smoothly for years. Advantages of this wide acceptance are worth every penny : interoperability among servers and decoders from various manufacturers is not the least.

## **What is an MPEG file ?**

MPEG streams are digital files containing images, sound, private data synchronized to the pictures and/or to the sound.

The standard allows for multiple sources in the same file. That way, many audios versions may be included within one movie file. These different versions will playout based on associated mtadata (data that describes data or relationships with other data), included with the file transmission.

The stream structure is devised to support transmission errors. The data is grouped in small packets with a code added at the end to control the integrity of the packet. Redundancy in the packet allows a decoder to automatically repair transmission errors.

MPEG compression is efficient : each picture is compacted like any fixed image could be by taking advantage of large zones of an image with similar colors or patterns. But MPEG is more clever than that : it uses also the coherency between consecutive images to remove from the transmission parts of an image already present in the previous one. This 'temporal redundancy' is one of the great features of the MPEG compression.

The MPEG standard allows for various qualities from Internet transmission, Broadcast TV and digital cinema. The MPEG flavor used for digital cinema is called High Profile @ High level or MPEG-2 HP @ HL. The native resolution of current movie files is 1920 pixels by 1080. Many picture rates are supported. Among those you will find 24 frames per second that is exactly what has been the standard for the cinema !

## **Security**

The actual digital encryption methods are a very good deterrent of movie thieves. A stolen digital movie may be decrypted by a good hacker. But... to defeat a good triple DES or AES encryption, you have to spend a lot of hours - certainly a few thousands hours at least, even on big computers - to find one decrypting key. In Digital Cinema the decryption key is changed every few seconds. This is one reason that may hold the pirates at bay for a long time. And you may be sure that the encryption methods will continue to improve over time in order to match the computing power available to the hackers.

Thus, the \$2.5 billion that is lost to movie pirates today will be greatly reduced.

A new architecture

Electronics is everywhere now...

But this is not a bad thing!

Replacing mechanical components with electronic ones implies the disappearance of moving parts, and thus of wear, dust accumulation and other sources of problems. We have to recognize that some moving parts remain in modern computers : the hard disks are rotating continuously, but those movements are rotations only and occur in sealed enclosures so no dust accumulation and a very slow wear of critical components.

In a classic (not to say old-style) theater, there is no backup in case of failure, there is only a very good reliability. You trust your projector and in case of failure, you sprint to your hand splicing tool and repair your broken film. Hopefully, this happens less than once a year and everybody stays happy. In the digital world, things are simpler to operate but far more difficult to repair. So, a new architecture is mandatory. In fact, things are complicated to the point that only a computer may repair a digital theater setup. Advantage of this situation : the repair is as fast as the mishap : nobody will be able to notice it!

In other words, all malfunctions should be repaired automatically. The operator is warned by a red light or a buzzer that something has gone wrong, but the show continues to playback without errors. Preventive and curative maintenance may be done between the shows. The digital cinema architecture is thus totally different from the traditional one and the whole thing is articulated around the word 'Redundancy'.

### **Multi-level redundancy**

Electronic transfer can be fast : tens or hundreds of megabits per second. Imagine being able to copy by hand a full small print dictionary every ten seconds or so without making a single misspelling. This ease of transfer opens the way to a great level of security : the basic idea is to have multiple locations where each movie is securely stored. In case of a local failure in one server, the images can be led to the projector from another server location. This concept has been integrated under the 'Store And Forward Exchange' acronym.

The movie is created in some studio, transferred to a post-prod facility, then through a satellite uplink center to a single screen theater or to the entry gateway of a multiplex. Finally, the movie is stored in the local server nearby or inside the projector itself. At all those steps, the images are stored and forwarded to the next stage. If the links are fast and reliable enough, this configuration creates by itself a redundant storage.

The closer to the projector, the more problematic is the reliability problem. That is why the electronic link between the gateway (the entry port for the movies in a multi-screen theater) and the screen is specially fast and reliable. Each movie is stored first in the gateway, then in the local server. In case of failure of the gateway, the shows remains securely stored near the projector. In the case of failure of the local server at the projector, the movie file is still stored in the gateway, which can play the file through the electronic link and directly to the projector.

The case of the single screen theater is slightly different : the gateway and the local server are integrated in a single device. In this case, the storage itself has been constructed with redundancy. The movie is stored twice on two different hard disks and most (not to say all) critical parts in the digital server are duplicated : the power supply, the input and output connections,...

### **Smart Cards and Encryption**

Electronic transfer can be fast and cheap but we don't want everybody transmitting our precious copyrighted movies fast and cheap ! This is the reason to use Encryption. Many kind of complex algorithms exist in the world to protect copyrighted content. We, at EVS, try to use open standards as soon as possible. So, we use the AES or 'Triple DES' methods that are well defined by international standards organizations.

Two main points should be emphasized to ensure a very good protection : First, the content remains encoded at all times. Second, the decoding keys are stored securely. The first point is solved with a good architecture. The second one can be solved with the use of SmartCards that remains in the hands of authorized people. This is safer than the passwords written on the back of your keyboard, handwritten notes in your agenda, etc.

### **The Local Server**

Small is beautiful

The local server is a small storage device with enough computing power to decrypt and play one movie at a time. The local storage capacity will be around 6 hours, just enough to store two full length shows. Such a device is not supposed to be huge : Just a little over 3 inches of rack space with a 19 inches width. In fact the local server is already small enough to be included inside the projector housing. Actually this is not yet due to the small quantities produced

for any single server/projector pair but things may change quickly...

### **But Cheap is also beautiful**

This small electronic package is at the heart of the movie playback setup. The compactness and the clever choice of inexpensive but carefully chosen elements will lead to major price reductions. This is critical for the success of any technology appearing on a new market. So be prepared for a price reduction by a factor of two or even more in the next couple of years.

### **EVS and the Digital Cinema Business**

EVS was coming out of nowhere six years ago in the slow-motion replay for TV, challenged Tektronix-Grass Valley and Sony in that field and now they are world leaders in that niche market with 80% of the worldwide systems in place!

This demonstrates that EVS is a committed and innovative company with the ability to react fast to a very targeted niche market. We may quote here the ubiquitous Patrick Von Sichowsky from ScreenDigest : "You may not be able to name five famous Belgians (please don't say Jean-Claude van Damme), but you should have no problem naming five Belgian D-Cinema companies. Just take Barco, EVS, Largo DMN, Kinopolis, Octalis and Cecis's parent company RMB and you have no less than six - most of them in a small radius of each others in Brussels. Maybe there is something in the water there."

Something in the Belgian water ?

### **About EVS**

EVS Digital Cinema is a new business unit of EVS Broadcast Equipment, S.A. The other activities of EVS group are in the field of broadcast equipment like the well known live slow-motion video storage (LSM) ; radio and audio servers by NETIA ; studio loudspeakers by FAR (Fundamental Acoustic Research). Many details are available on the web at [www.evs.tv](http://www.evs.tv) .

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