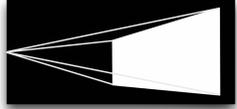


CINEMA D'EUROPA



MEDIA SALLES

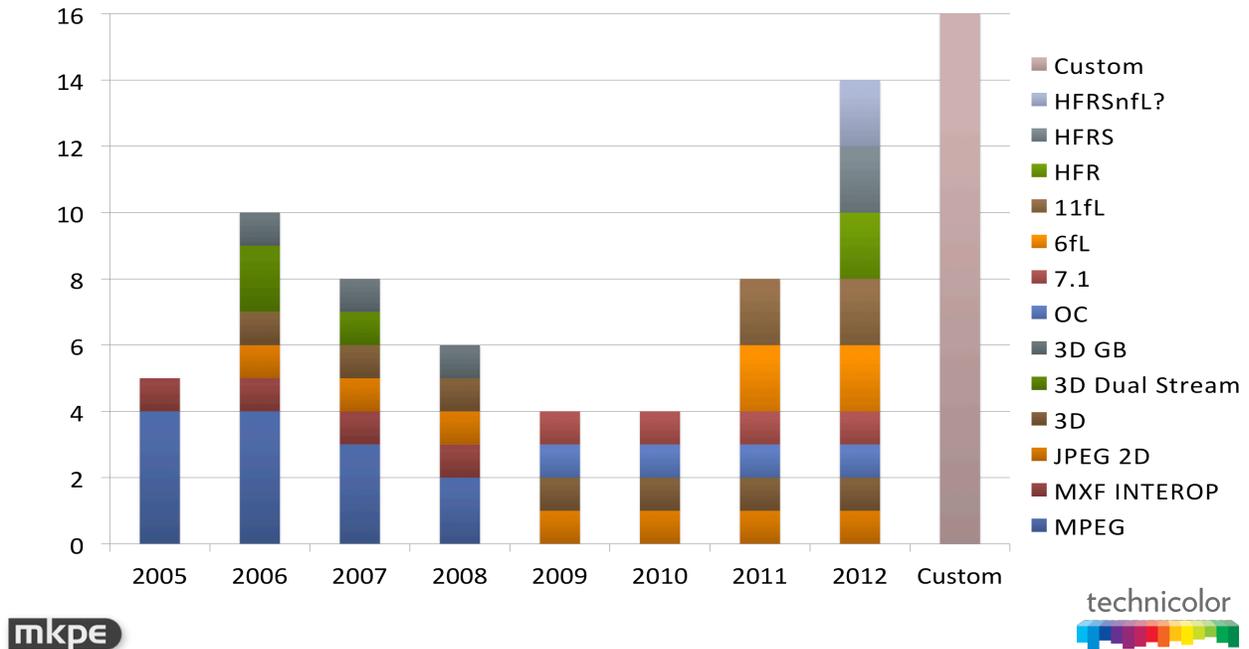
# Accessibility & Security Key Management

Michael Karagosian  
1 September 2012



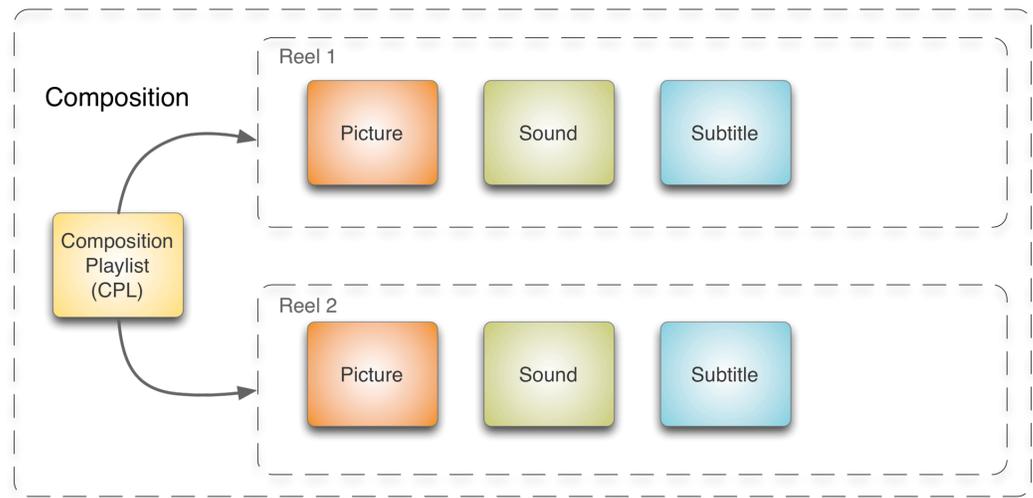
I'm Michael Karagosian, president of MKPE Consulting in Los Angeles. I have been engaged in business and technology development in entertainment for over 30 years, and have played an active role in the development and rollout of digital cinema for the past 12 years.

## The Content Management Problem ⇒ Key Management Problem



Distributors have been faced with the problem of multiple versions of digital content for many years. For a few years it appeared that the problem was under control. But this is no longer the case. The variety of versions that must be supported are growing, as shown in this graph by Technicolor.

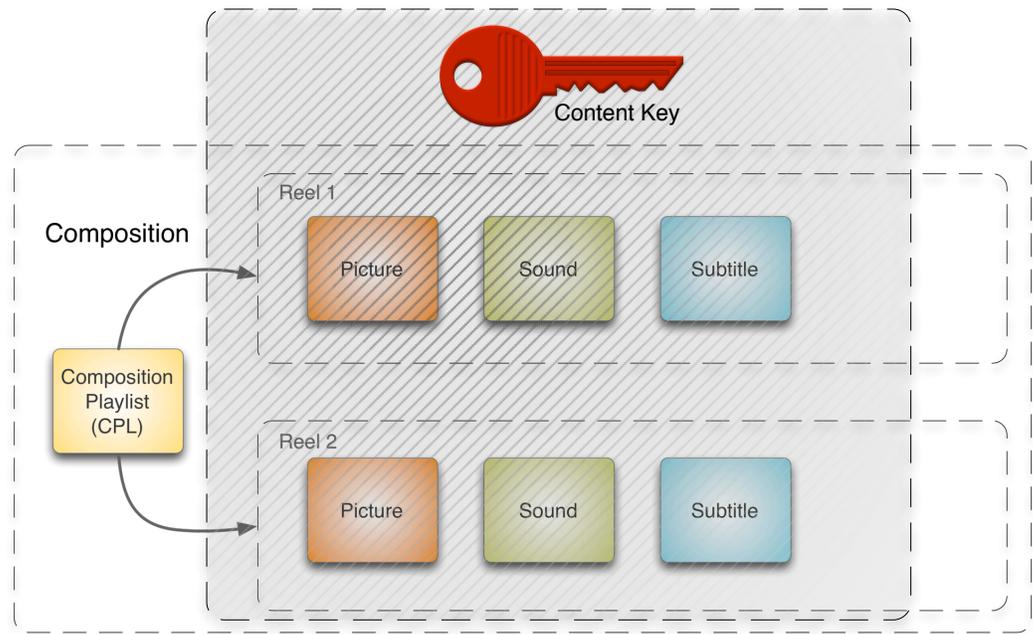
It Starts  
With The  
Composition



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The problem of content management and security key management starts with how content is packaged for distribution. A digital movie is called a Composition. The Composition consists of many files. Each file contains only one essence type, which means that picture is stored in one file, and sound in another. Files are organized temporally in blocks of time. We call these digital reels. While film reels strive to be of a similar length of time, digital reels can be of any length. There is no restriction on the number of digital reels in a Composition. The Composition was designed to be highly extensible.

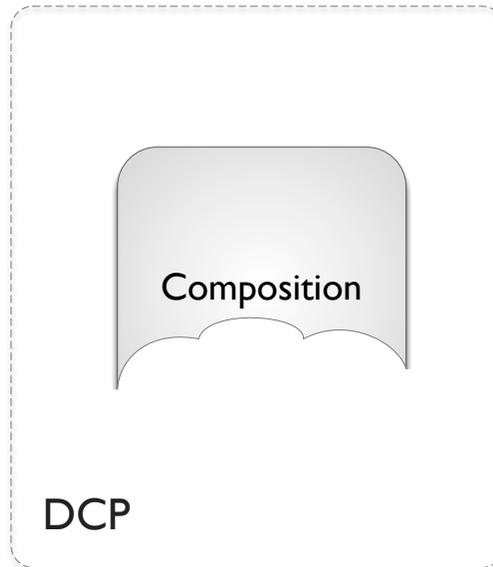
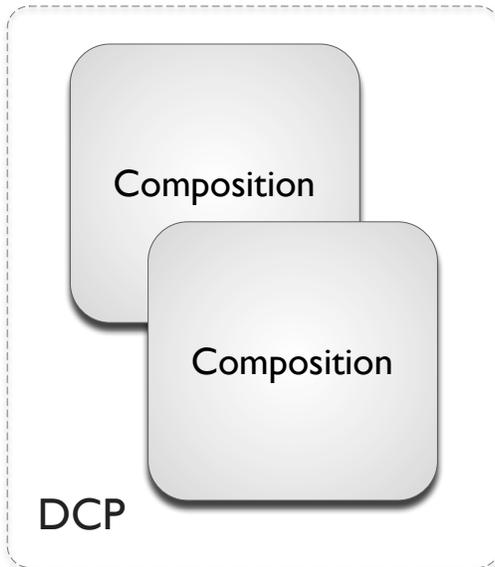
## Encrypted Composition



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If encrypted, each encrypted file in each reel requires a separate encryption key, and there is a limit of 256 security encryption keys that can be used in a Composition. The content owner chooses which files it wants to encrypt. The Composition Playlist, or CPL, is an XML file that instructs the playback system the order in which to decrypt and play the files.

## DCP: Digital Cinema Package

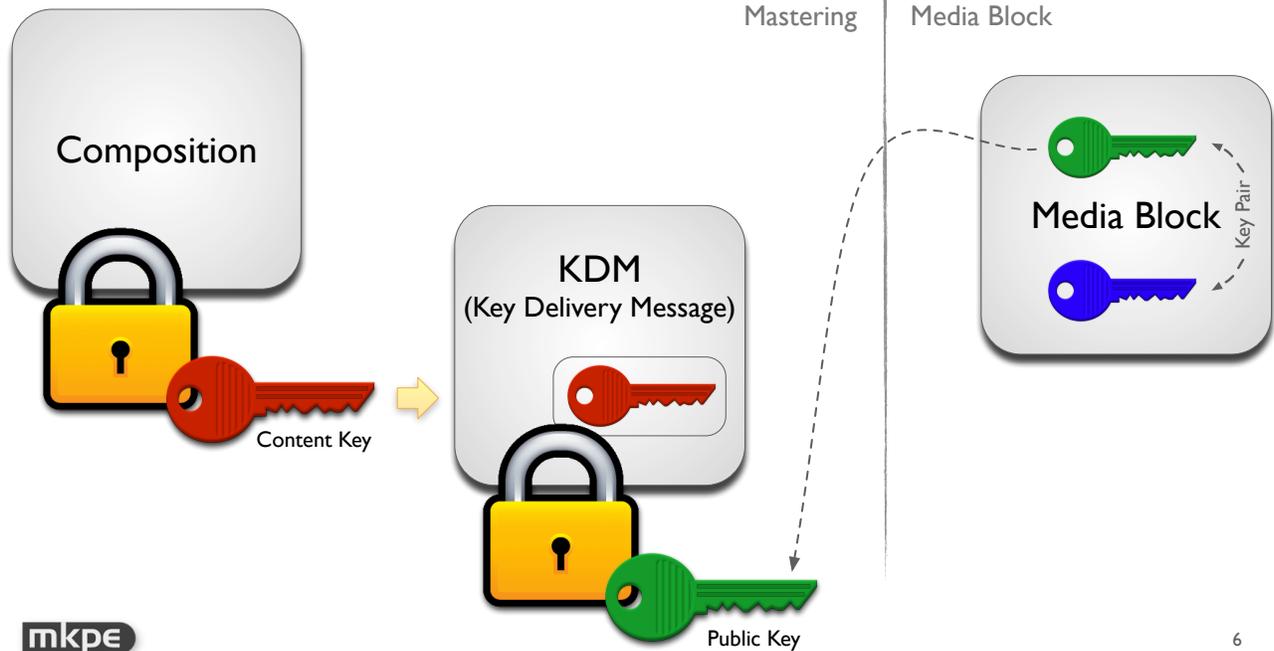


Every Version of an Encrypted Composition Requires a Unique KDM

Movies are stored as Compositions, but we talk about sending a “DCP” to the cinema. DCP stands for Digital Cinema Package. A DCP can contain one or more Compositions, or it can contain a partial Composition. Note that every version of the Composition requires a unique KDM.

Content management has two components. The first is that the right DCP must be sent to each site. Often, multiple Compositions are sent and the exhibitor must choose the right one to show. The more difficult problem is managing the security keys for each site.

# Security Key Management



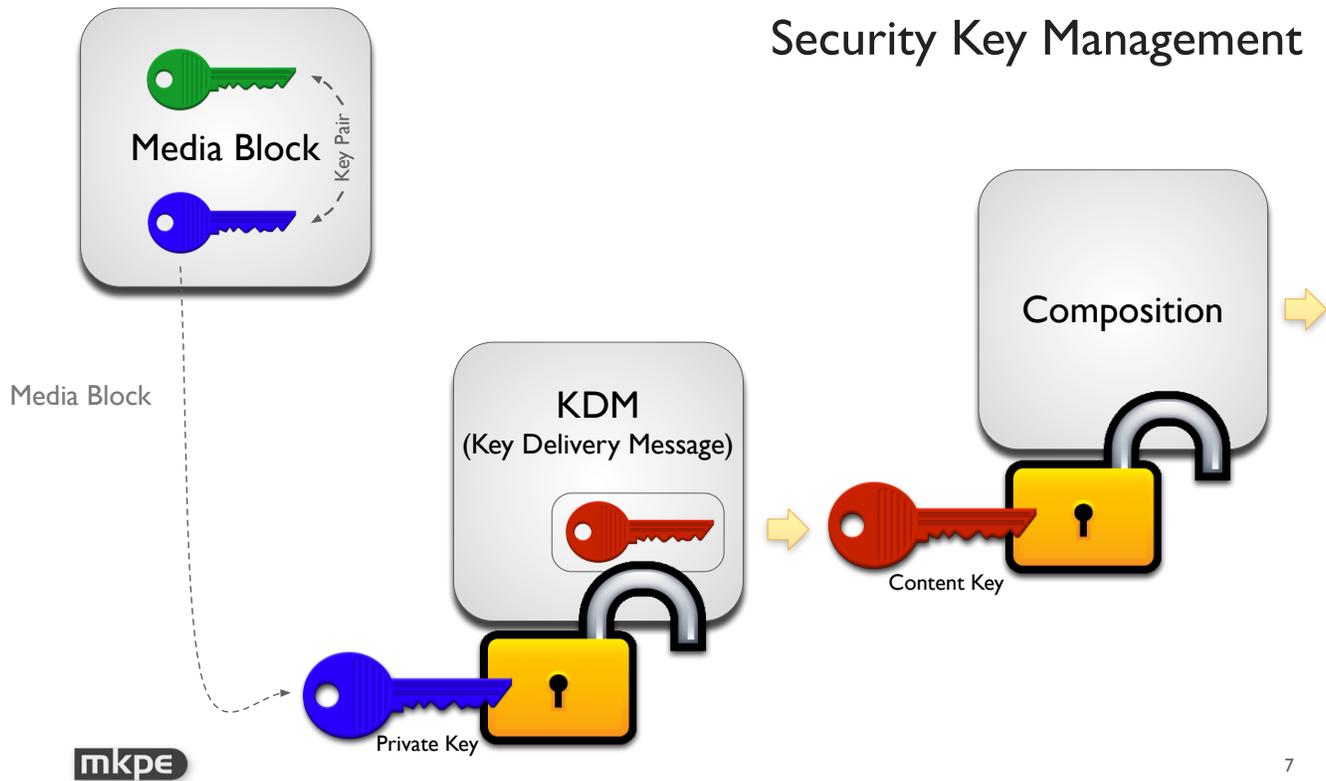
Film has no parallel to digital encryption. It is with security key management that most problems occur in exhibition. Let'

First, files in the Composition are encrypted, or "locked," with a "symmetrical" key, which I refer to here as a "Content Key" (red key). Symmetrical means that the same key that is used to encrypt a file can also be used to decrypt the file. When a Composition is widely distributed in a region, the same encrypted set of Composition files is sent everywhere.

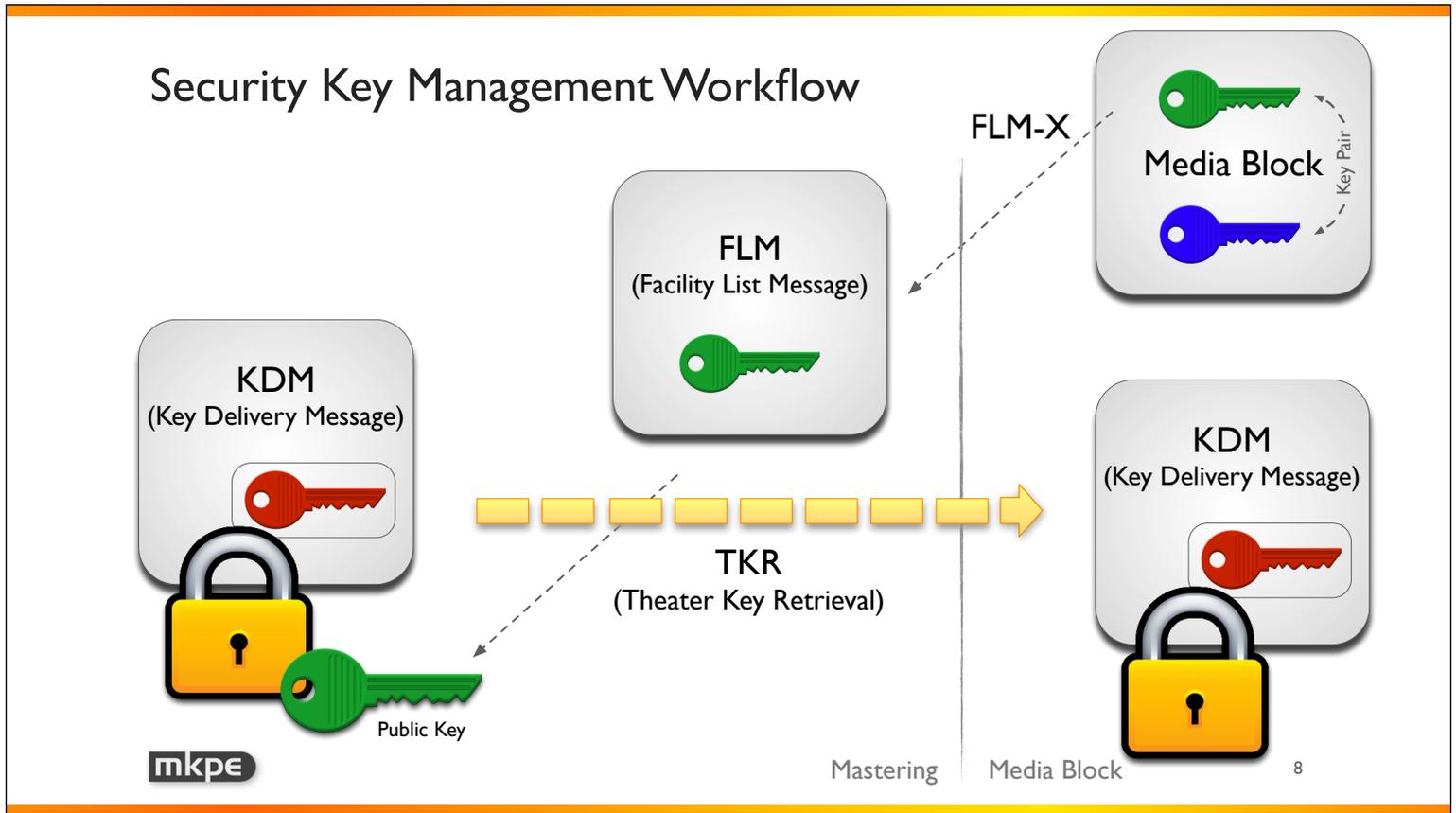
To protect the Content Key, it is encrypted, or "locked," in separate file called a Key Delivery Message, or KDM. The KDM is a small file, and can be emailed. Each KDM is uniquely created to play in only one digital cinema Media Block. (The Media Block decrypts, decompresses, and plays the Composition.)

The "Public Key" (green key) used to encrypt the KDM is received from the Media Block that will decrypt it. It is an asymmetrical key. As the name implies, it can be exposed to the public without compromising the encryption. Only the "Private Key" (blue key) of the Media Block can decrypt the KDM. Private Keys are encoded in secure silicon, and cannot be seen by human eyes.

## Security Key Management



When the KDM is delivered to the Media Block, the Private Key (blue key) decrypts it, and exposes the Content Key (red key). The Content Key can then be used to decrypt the Composition. These tasks are all performed in secure silicon. A major portion of the DCI specification addresses how these secure processes are to be handled.



As in any work environment, we have workflow issues in the exhibition of digital movies. Media blocks move around or can be replaced on a moment's notice. It takes a lot of care to make sure that the right KDMs are present in the cinema so that the movie plays. To carry the Public Key (green key) from the cinema to the KDM maker requires a Facility List Message, or FLM. A communication method called FLM-X is used to collect the FLM.

Once the KDM is created, it needs to be sent to the right location. To accomplish this, a method has been devised called Theatre Key Retrieval (TKR) to allow the Media Block to pull the correct KDM from a data center.

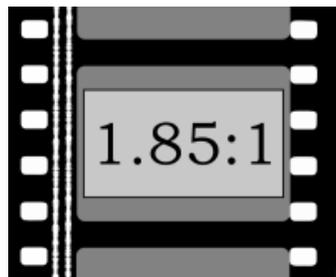
Accessibility



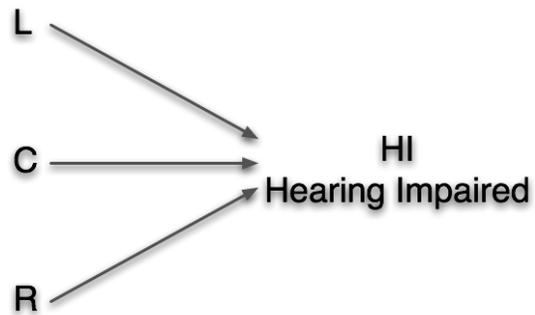
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Now let's talk about accessibility, and how accessibility is improved in digital cinema over film.

## Hearing Impaired (HI) - How It Used To Be



Stereo  
Sound



Signal Summed in Audio Processor

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With film, the Hearing Impaired audio channel, or HI audio, was created by the audio processor.

Visually Impaired Narrative (VI-N)  
*also known as Descriptive Narration*  
- How It Used To Be



With Film, VI-N was only possible with DTS

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With film, the Visually Impaired Narrative channel, known as VI-N, or Description Narration, was only available with the Accessibility Disc for DTS systems.

## HI & VI-N With Interop DCP

Container Channel	Configuration			General Loudspeaker Position
	5.1	7.1 SDDS	7.1 DS	
1	L	L	L	Left
2	R	R	R	Right
3	C	C	C	Center
4	LFE	LFE	LFE	Low frequency effects
5	Ls	Ls	Lss	Left surround (or left side surround)
6	Rc	Rs	Rss	Right surround (or right side surround)
7		HI		Hearing impaired (with emphasis on dialog)
8		VI-N		Visually impaired narrative (audio description)
9	--	Lc		Left center
10	--	Rc	--	Right center
11	--	--	Lrs	Left rear surround
12	--	--	Rrs	Right rear surround
13		Motion Data		Synchronous signal (currently used by D-Box)
14	--	--	--	Unused at this time
15	--	--	--	Unused at this time
16	--	--	--	Unused at this time



In digital cinema, HI and VI-N audio are delivered in the Composition. This is very simple with Interop DCP. No special equipment is needed to retrieve HI and VI-N audio.

# HI & VI-N With SMPTE DCP

Container Channel	Interop DCP (This is how cinemas are wired)	SMPTE DCP 5.1	SMPTE DCP 6.1	SMPTE DCP 7.1 SDDS	SMPTE DCP 7.1 DS	SMPTE DCP Channel Labeling
1	Left	Left	Left	Left	Left	Channels Can Be In Any Order
2	Right	Right	Right	Right	Right	
3	Center	Center	Center	Center	Center	
4	LFE	LFE	LFE	LFE	LFE	
5	Left Surround	Left Surround	Left Surround	Left Surround	Left Side Surround	
6	Right Surround	Right Surround	Right Surround	Right Surround	Right Side Surround	
7	Hearing Impaired	Hearing Impaired	Center Surround	Left Center	Left Rear Surround	
8	Visually Impaired Narrative	Visually Impaired Narrative	---	Right Center	Right Rear Surround	
9	Left Center	---	Hearing Impaired	Hearing Impaired	Hearing Impaired	
10	Right Center	---	Visually Impaired Narrative	Visually Impaired Narrative	Visually Impaired Narrative	
11	Left Side Surround	---	---	---	---	
12	Right Side Surround	---	---	---	---	
13	Motion Data	---	---	---	---	
14	---	---	---	---	---	
15	---	---	---	---	---	
16	---	---	---	---	---	



But it becomes more complex with SMPTE DCP. SMPTE DCP assumes that the media block will correctly route the audio channels to the correct output. However, DCI compliance testing does not test for this. If your server does not route audio, it will lead to problems with SMPTE DCP distributions.



Closed  
Captions  
began...

Rear  
Window®  
Captioning  
System

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For the audibly impaired, captions can be placed on-screen. However, audiences in the US, and perhaps elsewhere, prefer to NOT have captions on-screen. The Rear Window closed caption system was originally introduced for film.



## Rear Window<sup>®</sup> Captioning System

Rear Window had a  
monopoly in film

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Rear Window utilizes a transparent reflector, reflecting text emitted from a digital sign on the rear wall of the auditorium.

Due to the degree of patents and licenses associated with Rear Window, it enjoyed a monopoly in film.

## Closed Captions in Digital Cinema are Open

- Open distribution
- Open interoperability

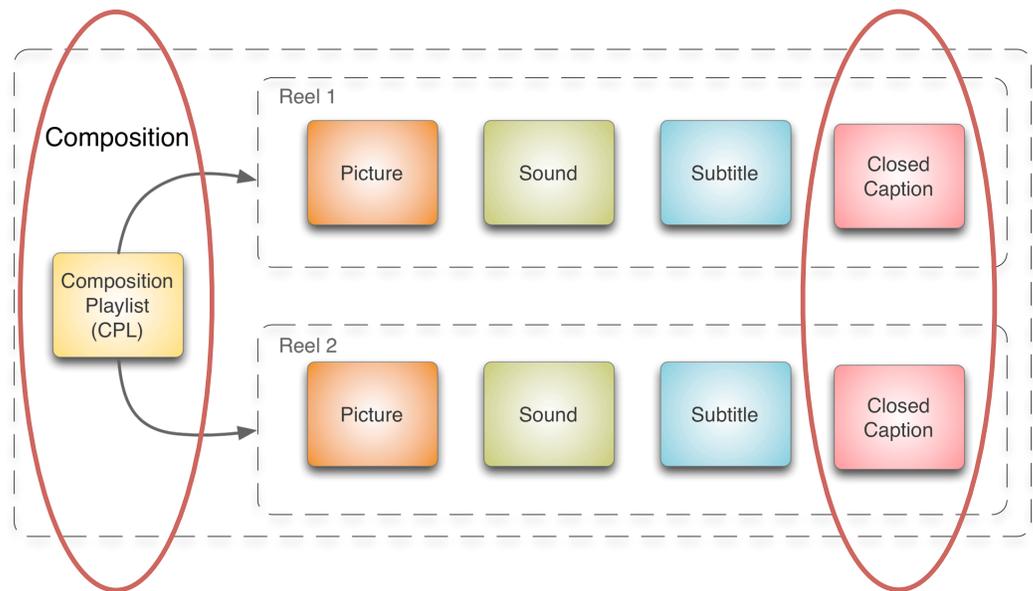
Openness allowed a competitive product environment to emerge, reducing costs to both distributors and exhibitors.



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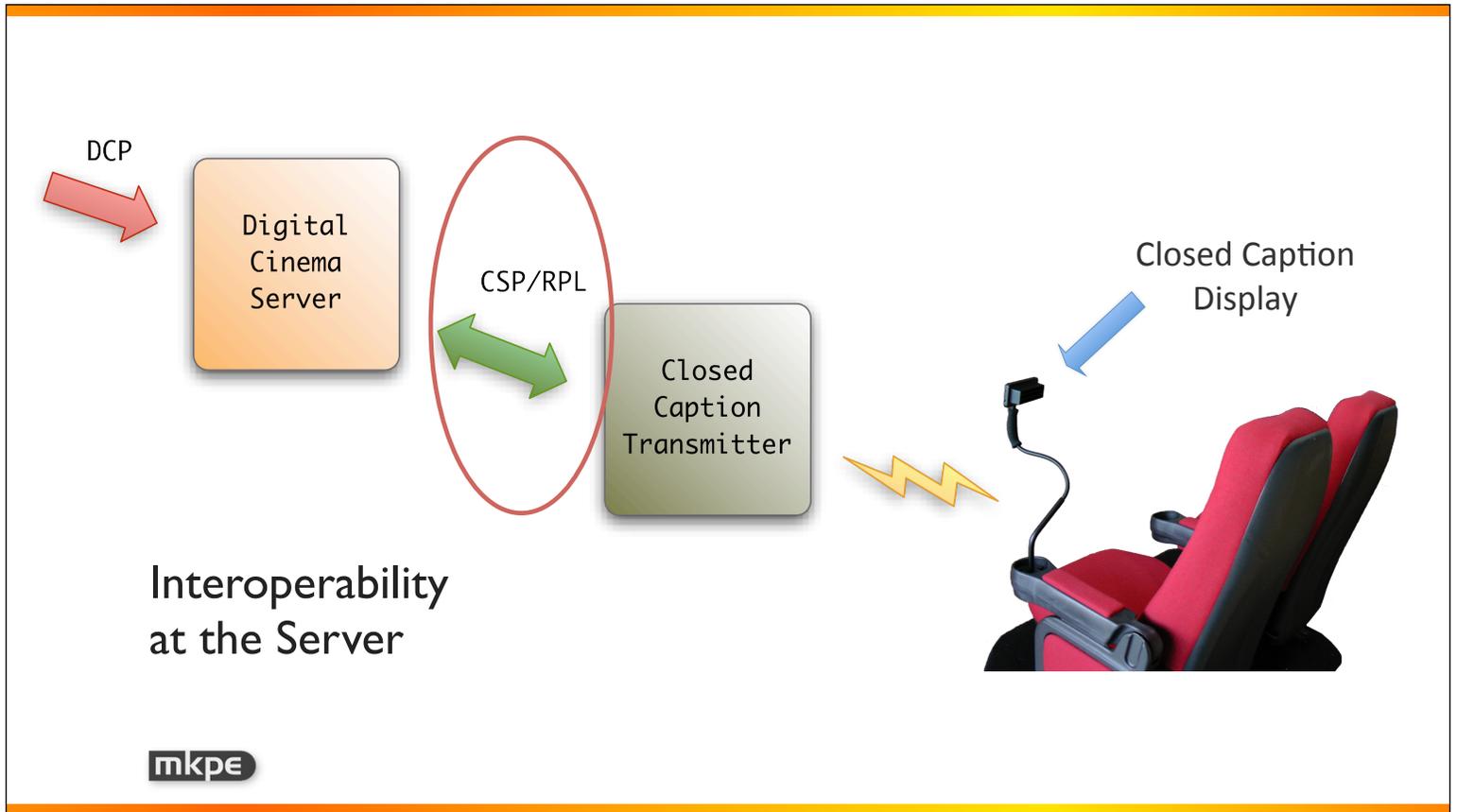
Digital cinema opens up closed captions. There are no licenses associated with closed caption content in digital cinema, and all systems support an open protocol for 3rd party closed caption systems.

## Closed Captions in the Composition



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Back to the Composition, closed captions were introduced into distribution by adding a new file type to the Composition, and by extending the CPL. Note that DCI compliance testing does not test for the ability to read a closed caption track file.



To allow 3rd party closed caption displays to connect to the digital cinema server, a new communication tool was invented, called the CSP/RPL protocol. CSP stands for Content Synchronization Protocol, and RPL stands for Resource Presentation List. All servers sold today support CSP/RPL. However, note that DCI compliance testing does not test for CSP/RPL.



The introduction of open closed caption track files and the CSP/RPL protocol has led to the introduction of competitive accessibility products. USL makes infrared-driven HI / VI-N audio and closed caption products.

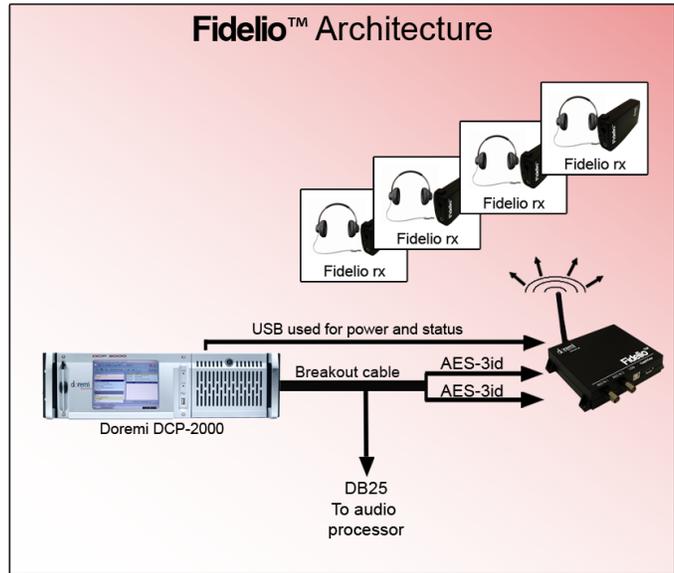


Doremi makes a closed caption display called Captiview driven by an industrial wireless protocol standardized by IEEE.

doremi™



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Doremi also makes the Fidelio system for HI / VI-N audio, also driven by an industrial wireless protocol standardized by IEEE.

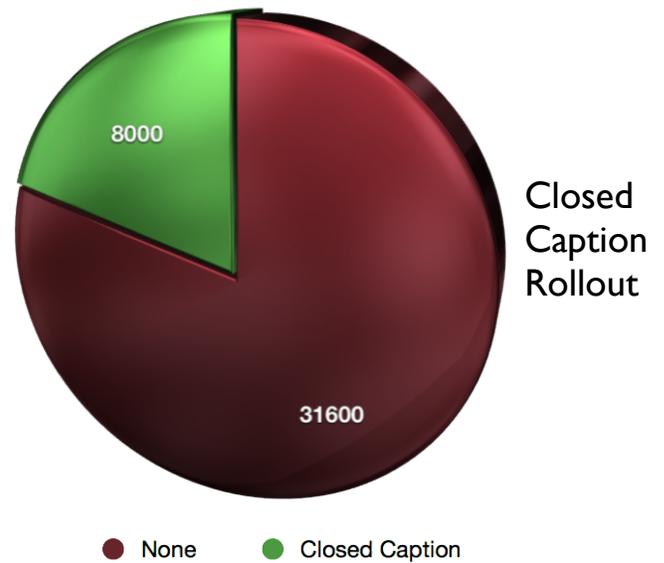
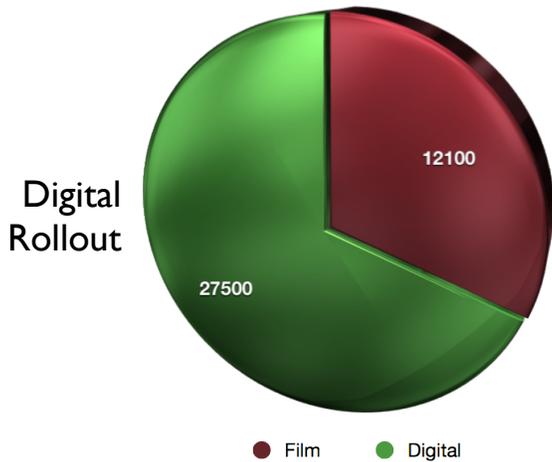


Sony makes closed caption glasses, that prints text in front of the audience member's eyes. The glasses are driven wirelessly, and the transmitter / receiver also supports HI / VI-N audio.



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Some developers are considering the introduction of closed caption products using an off-the-shelf tablet as the display. What would be your reaction to such products?



US Cinema Market  
March 2012



In March, the US had rolled out closed captions to nearly 8000 screens. That number may double by year-end.

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