



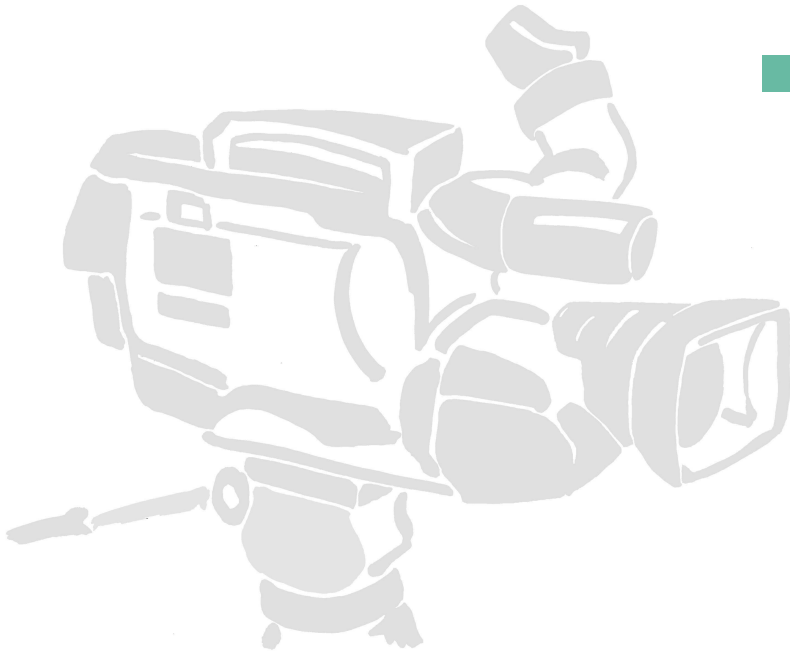
Motion JPEG2000 and Digital Cinema

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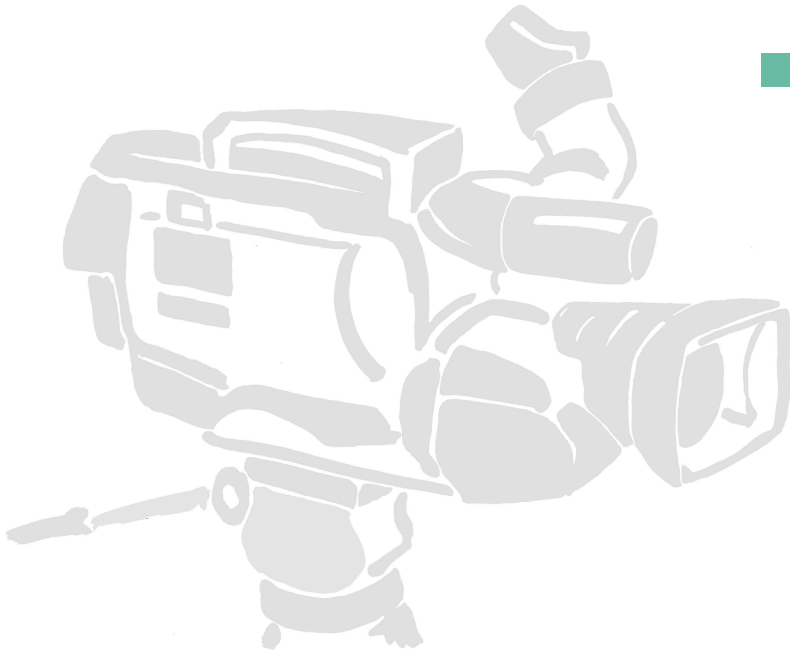
www.dcinema.fhg.de

Motion JPEG2000: General Key Features (1)



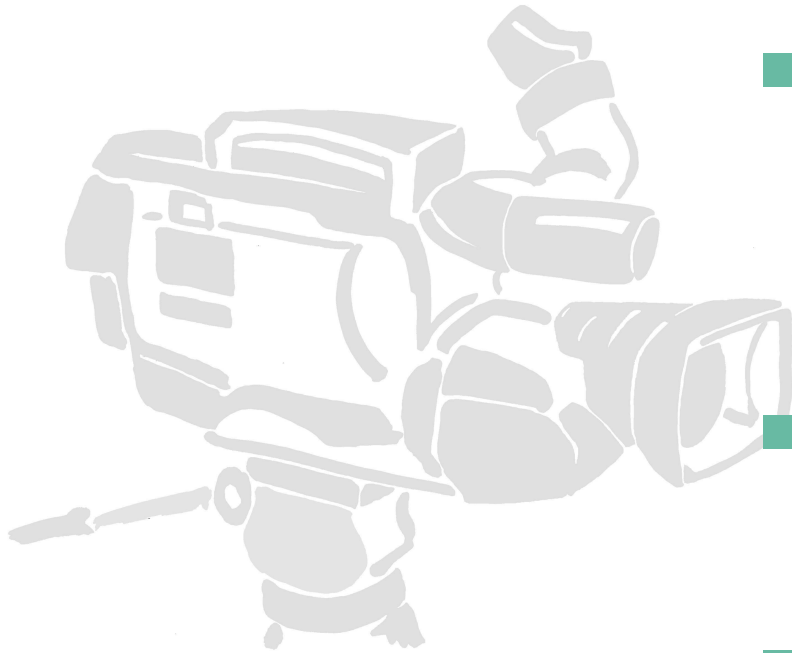
- based on Part 1 codec of JPEG2000 standard (15444-1)
 - lossless and lossy compression in one codec
 - scalability in resolution and quality
 - Accuracy depth up to 32 Bit/component
 - Image width and height up to $(2^{32}-1)$
 - Quality based, VBR, CBR coding, high efficient

Motion JPEG2000: General Key Features (2)



- Motion Image specific additions
 - intraframe based coding scheme
 - MPEG-4 based file format
 - Synchronisation of audio and video
 - Metadata embedding
 - Multi-component, multi-sampling formats
e.g. YUV422, RGB 444

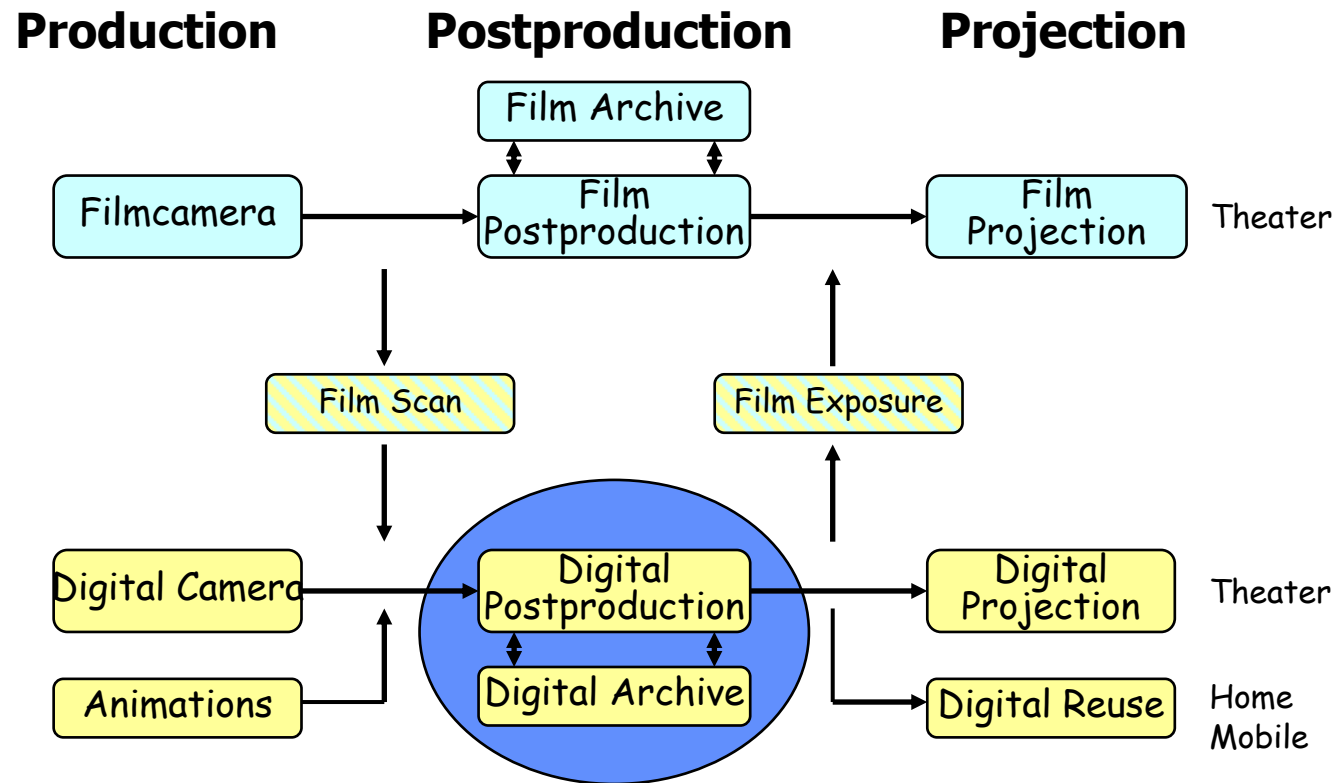
D-Cinema specific advantages by using the features



- **Intraframe Coding**
Easy editing,
individual frame access, forward/backward spool,
relative low memory demands
=> one 4kx2k frame uncompressed about 32 MByte
- **Scalability**
Previews in different resolutions and qualities
=> good for use of displays and networks
- **Lossless and near lossless**
no losses in postproduction



D-Cinema workflow





Motion JPEG2000 Compliance Point 3 (D-Cinema)

- Image Size: 4096x3112
- Image quality: RGBA 4444 / 16 Bit
- Number of Layers: 15
- Number of Transform Levels: 5

A Motion JPEG2000 Cpoint 3 decoder should cover both production and projection formats





Motion JPEG2000 Compliance Point 3 (D-Cinema)

A compliant Motion JPEG2000 Cpoint3 decoder should cover the most used and proposed digital cinema image formats:

Digital production formats:

- 35 mm Scan 4096x3112
- Cameras (DALSA, Olympus) 4064x2048, 3840x2064 (1Chip)

Digital projection formats:

- DCI (1.85:1) 3790x2048 / 2842x1536
- (2:1) 4096x2048
- (2.39:1) 4096x1714 / 3672x1536

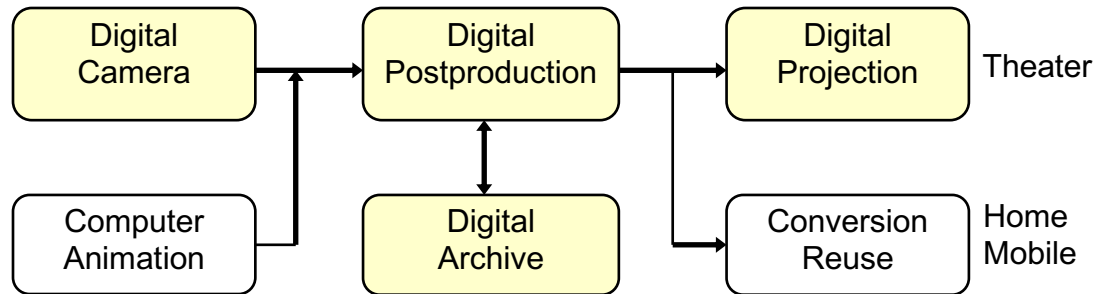




Digital Cinema – Requirements Bitdepth and Color

Preferred scope of application:

- Production
- Postproduction



S/N headroom > 10 dB



Production
10-16 Bit/Component
RGB 444

Projection
8-10 Bit/Component
YUV 422





Digital and Electronic Cinema Parameters

TABLE I
TYPICAL PARAMETERS ON DIGITAL AND ELECTRONIC CINEMA SYSTEMS

	Electronic Cinema	Digital Cinema Production	Digital Cinema Projection	MJ2K Compliance Point 3
Image Size in Pixel	1280x720 - 1920x1080	1920x1080 -	1920x1080 -	4096x3112
Number of Comp.	3	3-4 DPX 8	3	4
Color space	RGB or YCrCb	RGB	RGB or YCrCb	RGB
Bit Depth	8-10 Bit/Comp.	12-16 Bit/Comp.	10 Bit/Comp.	16
Sampling Mode	4:2:2	4:4:4	4:2:2	4:4:4
Frame rate	24 fps and other fixed	24 fps and variable	24 fps and other fixed	*

* Only a minimum frame rate, which the decoder can sustain, shall be decoded





Digital and Electronic Cinema – typical examples

An example is the NTT 4k projection system, which uses JPEG2000 for real time decompression.

Application	Projection Electronic Cinema	Production HDTV	Projection Digital Cinema (NTT)	Production Digital Cinema (35mm)
Parameter	1280x720 YUV422 16 Bit 24fps	1920x1080 YUV422 20 Bit 24fps	4096x2048 RGB444 30 Bit 24fps	4096x3112 RGB444 36 Bit 24fps
Resulting datarate	350 MBit/s	995 MBit/s	6040 MBit/s	11000 GBit/s
Typical compression ratio	20:1 => 17,5 MBit/s	7:1 => 140 MBit/s	<12:1 => 450 MBit/s	5:1 => 2200 MBit/s

Seite 10





Performance of Motion JPEG2000

Testsequence:
Bike and Screen [MPEG]

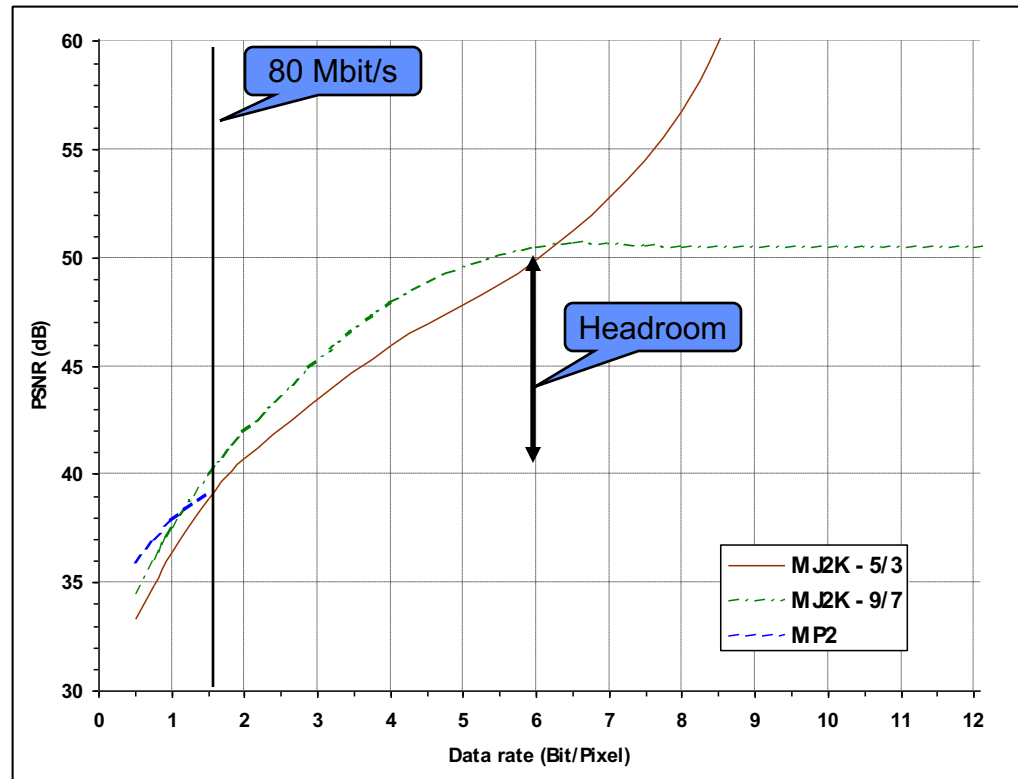


Image:
1920x1080
RGB 24Bit
1 Tile

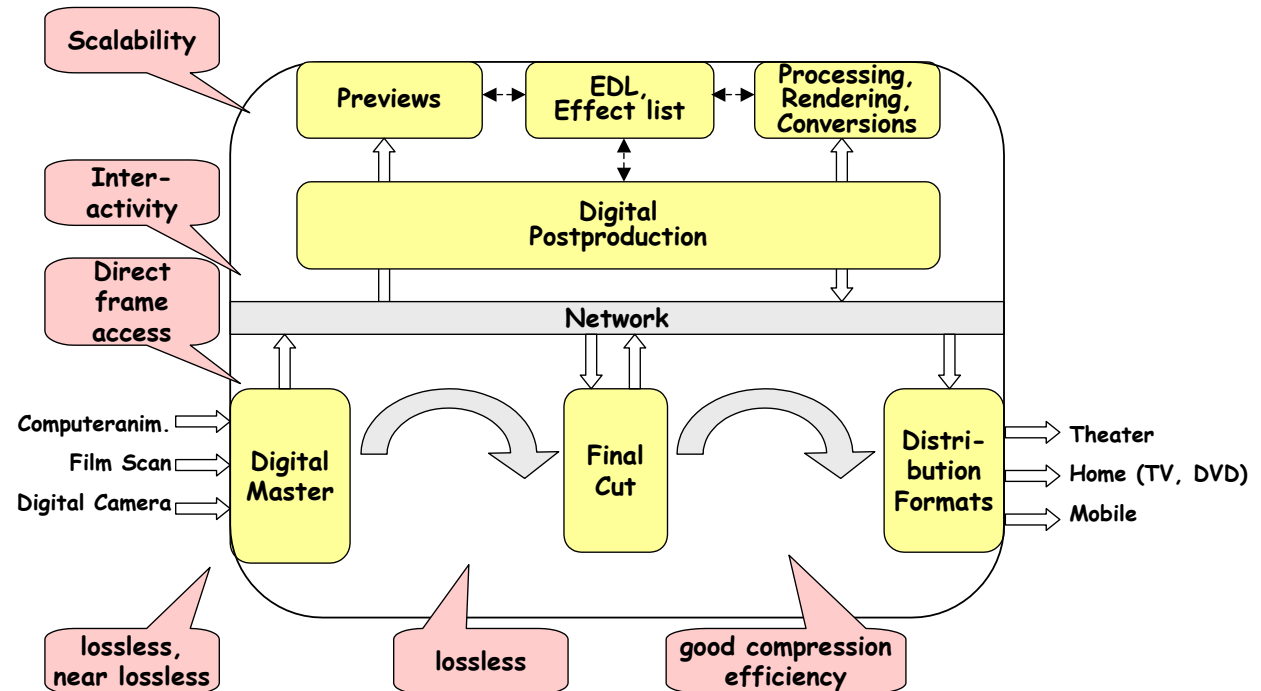




Digital Cinema – System integration

Advantages:

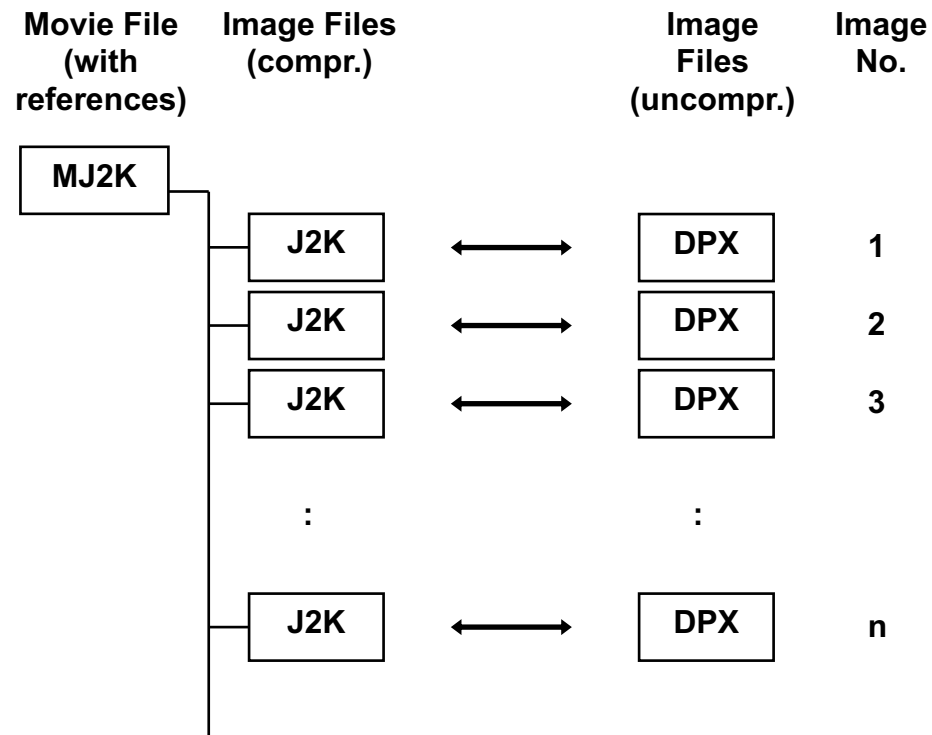
- Editing (Frame access)
- Network (Scalability)
- Lossless compression





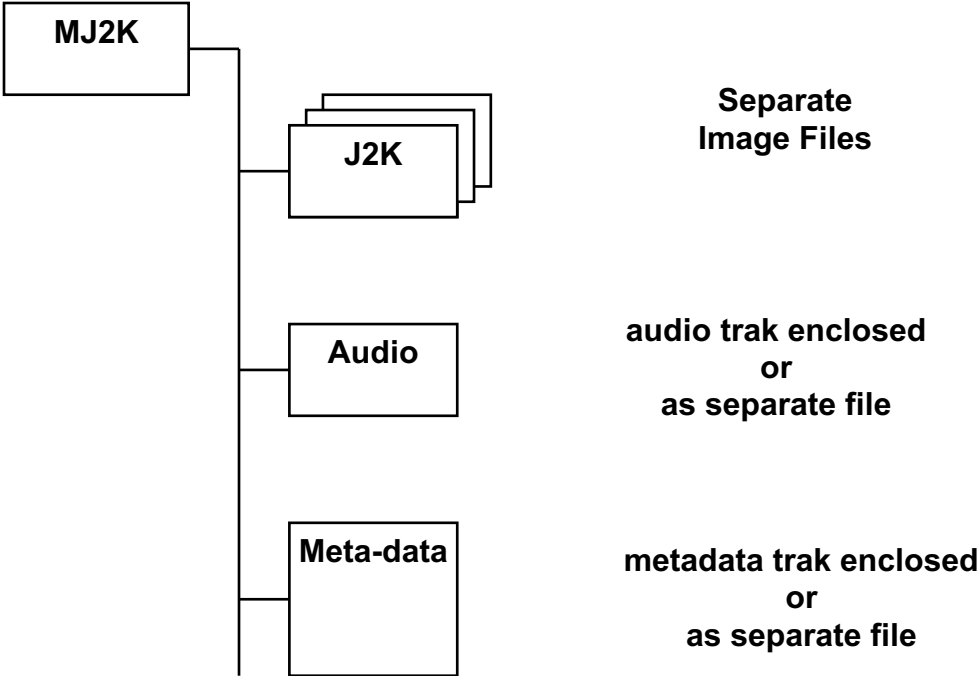
Digital Cinema – File format exchange

Smooth transition from
DPX to MJ2K possible





Digital Cinema – File format additions



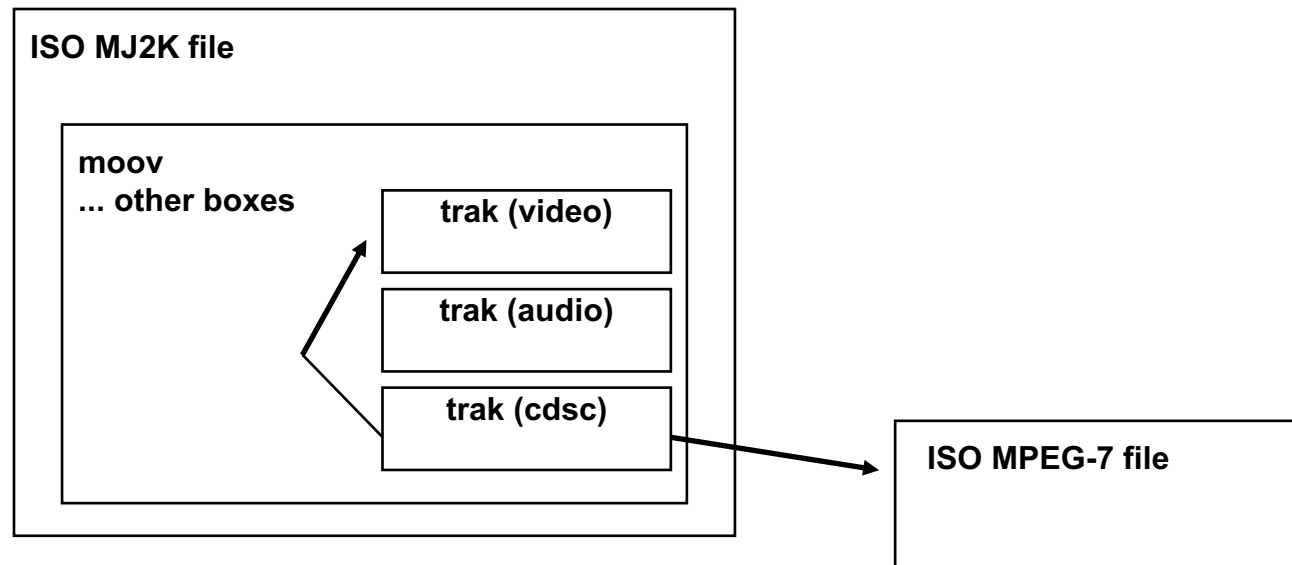


Digital Cinema – Metadata use

Metadata:

-standard metadata
embedded in MJ2K file
(e.g. framerate, duration,..)

-additional time-related trak
in MPEG-7 file possible
(content description)





Digital Cinema – Possible Additions

- Part 8: JPSEC (Secure JPEG2000)
 - Encryption support, partially access

- Part 9: JPIP (Interactivity tools, APIs and protocols)
 - Optimized network access
 - Efficient use of scalability





Motion JPEG2000 components

- JPEG2000 Chips:
 - Analog Devices, Ricoh, Amphion
- FPGA solutions:
 - FHG IIS, Xilinx, Amphion et al.
- Software solutions (mostly JPEG2000):
 - many, e.g. Adobe, Algovision, Aware, Uni New South Wales





Conclusion

- Motion JPEG 2000 is a completion to MPEG standards, where
 - intraframe coding
 - preservation of highest quality
 - scalability
 - low delay times between encoding and decoding is requested.

Digital Cinema requires such features.

