

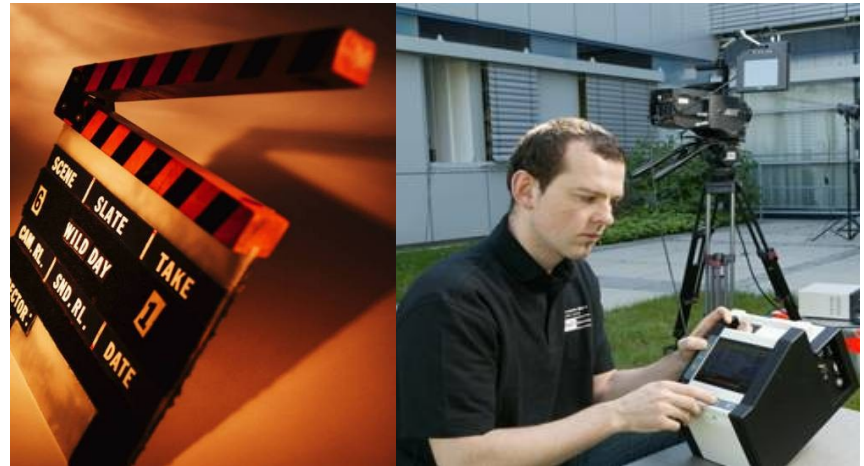
# JPEG 2000 Archive Profiles

Fraunhofer Digital Cinema

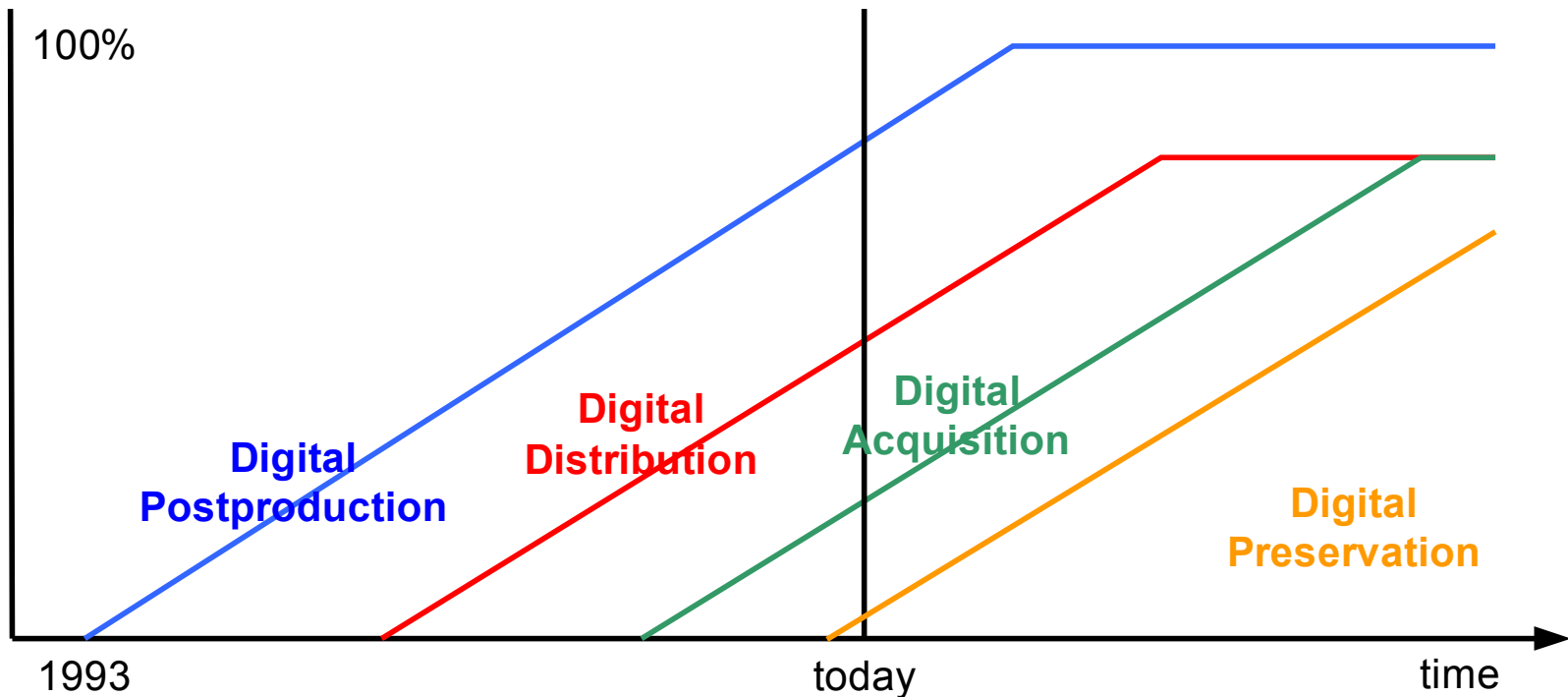
**Joachim Keinert**, Siegfried Föbel

1st Int. Workshop on Standards  
and Technologies in Multimedia  
Archives and Records (STAR)

Lausanne, 2010-04-26/27  
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- **Development of the Digital Cinema**  
**Digitization**



# 1. Archives - The Problem Area

## Transition from film to digital cinema is on its way

- How to simplify access to existing analogue material?
  - Digital viewing copy
- What are the future digital movie formats for archives?
- In which way is it possible to access these archives?
- How to organize and manage archives such that costs remain acceptable?

- **EDCINE**  
**Project Goals**

- European research project with 20 Partners funded by EC in FP6 (7/2006-6/2009)
- Develop a system concept for a digital film archive
- Build a demonstrator

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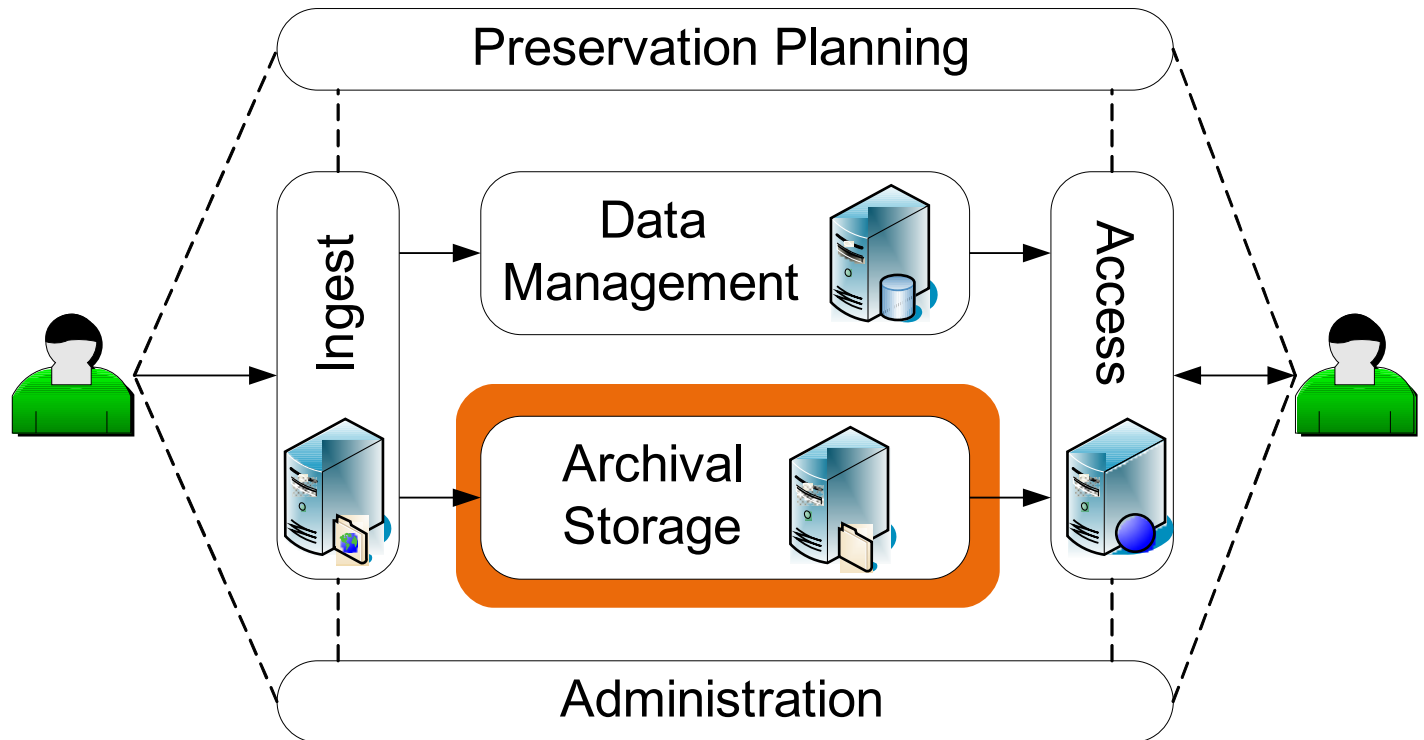
# JPEG 2000 Archive Profiles

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1. Introduction
2. System Concept for Digital Archives
  - Archive Packages
  - Data Organization within Archive Packages
  - Use Cases
  - Metadata & Packaging
1. Demonstrator System
2. Conclusion
3. Future Trends and Requirements

- **System Concept Overview**

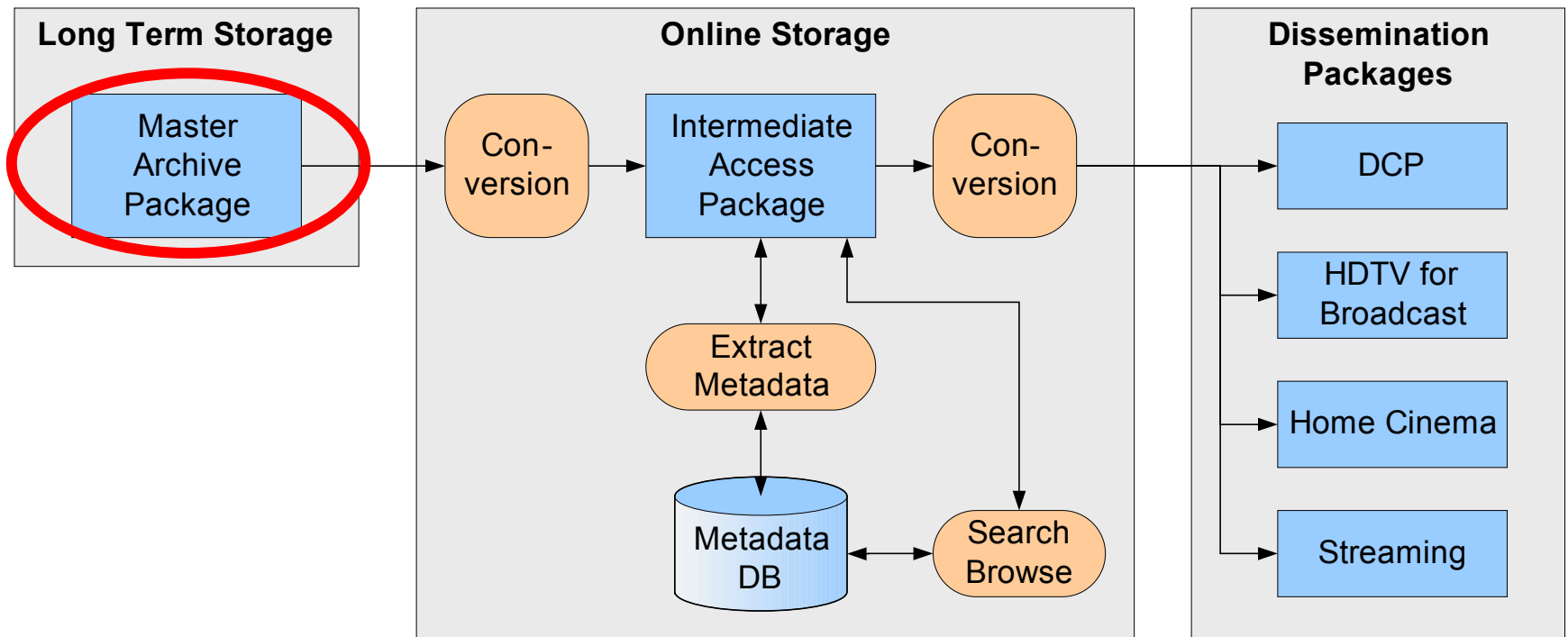
## OAIS Reference Model (ISO Standard)



- **System Concept**  
**Requirements**

- Requirements
  - Reliable storage of unmodified movie content
  - Flexible and fast access to archived data
- Needs both large files and fast access
  - Contradictory
- Two-tier data format
  - Master Archive Package (MAP) for conservation
  - Intermediate Access Package (IAP) for access
- Dissemination Packages created on demand

- **System Concept**  
**Two Tier Data Format**





- **System Concept**  
**The Master Archive Package**

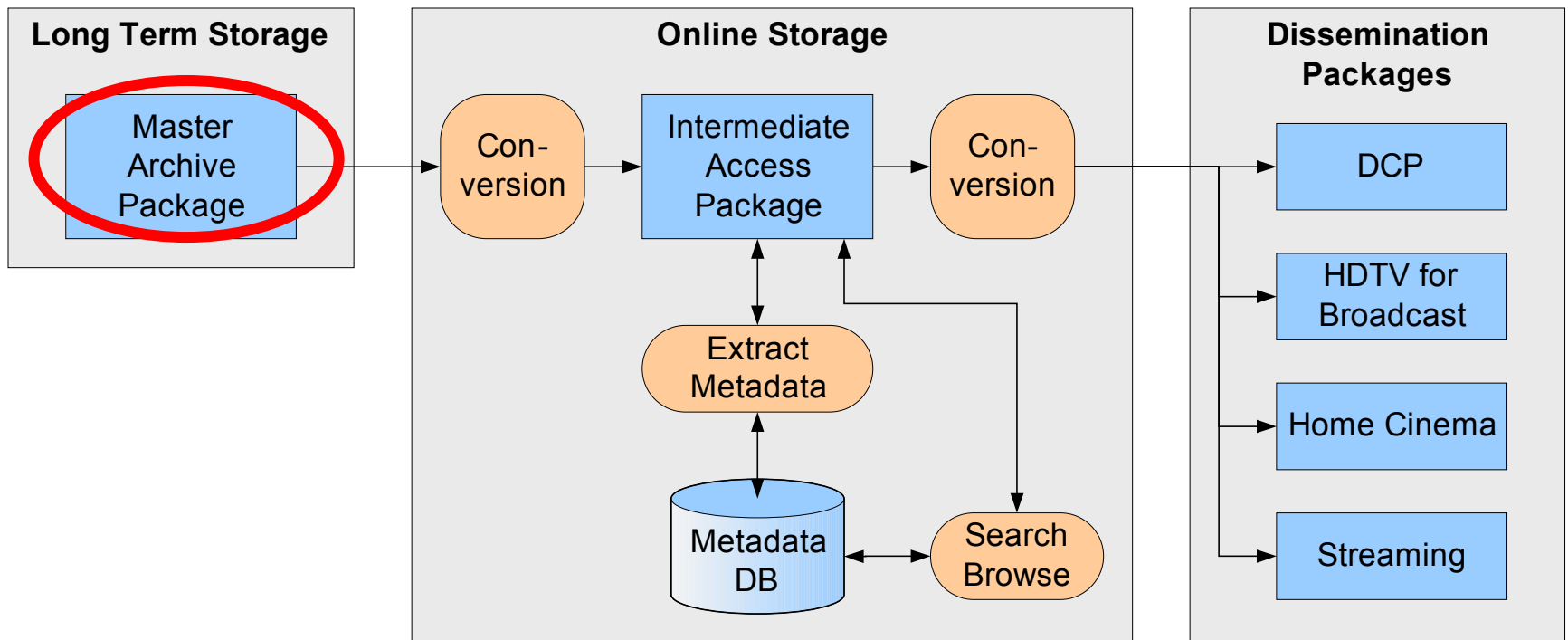
- **Main goal: Preservation of original data**

- Typical characteristics:

- Lossless compression
- Arbitrary (highest justifiable) resolution
- Original frame rate of the source
- Can contain the whole film area, including soundtrack, sprocket holes etc.
- Metadata for Management

- Not optimal for distribution

- **System Concept**  
**Two Tier Data Format**



- **System Concept**  
**The Intermediate Access Package**

- **Main goal: Access copy of archived item**
- Typical characteristics:
  - Lossy compression (up to 500 MBit/s)
  - Fixed resolution (e.g. 2048 x 1080)
  - Fixed frame rate (e.g. 24 or 48 FPS)
  - Contains only projectable image area
- Compatible to SMPTE DC28 standards for simple distribution
  - DCPs can be created without image recoding
  - Ideal to generate dissemination packages

- **System Concept**  
**Data Organization within Archive Packages**

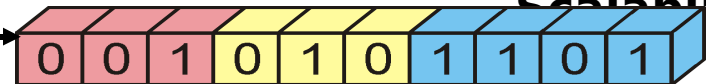
- Image Encoding
  - JPEG 2000
  - Open and well-documented standard (ISO/IEC 15444-1:2004)
    - Important to guarantee long term accessibility
  - Royalty free (Part-1 sufficient for archiving)
  - Possibility to store lossless and lossy
  - Scalability for conversion to other resolutions and quality levels
  - Intra-frame compression
    - Simple manipulation
- Audio, subtitles, text, still images, ...
- Metadata

- **Image Encoding with JPEG 2000**  
**Scalability**

**Scalable Dataformat  
for  
Digital Cinema and  
Archives**



**Encoding**



Scalable Bitstream

**Resolution  
n  
Scalability**

- **Image Encoding with JPEG 2000**  
**JPEG2000 ISO Profiles Relevant for Digital Movies**

- Purposes

- Reduce complexity for better compatibility
- Simplify access

- Distribution

- 2k Distribution Profile (2K digital cinema profile)
- 4k Distribution Profile (4K digital cinema profile)

- Intermediate Access Package

- 2k scalable Archive Profile (Scalable 2k digital cinema profile)
- 4k scalable Archive Profile (Scalable 4k digital cinema profile)

- Master Archive Package

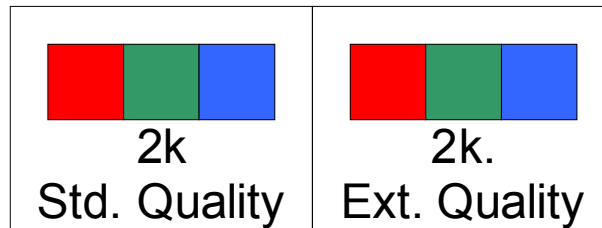
- Master Archive Profile (Long-term storage profile)

- **Image Encoding with JPEG 2000**  
**JPEG2000 ISO Profiles Relevant for Digital Movies**

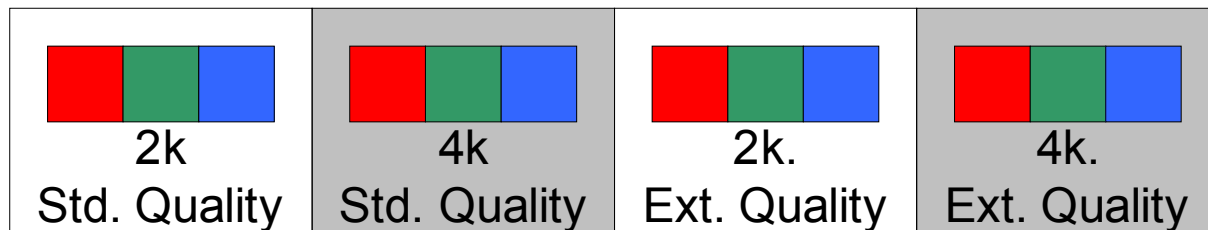
| Profile           | 2k<br>Distributio<br>n Profile | 4k<br>Distributio<br>n Profile | 2k scalable<br>Archive<br>Profile                | 4k scalable<br>Archive<br>Profile                | Master<br>Archive<br>Profile |
|-------------------|--------------------------------|--------------------------------|--------------------------------------------------|--------------------------------------------------|------------------------------|
| Profile Indicator | 3                              | 4                              | 5                                                | 6                                                | 7                            |
| Max Resol.        | 2048x1080                      | 4096x2160                      | 2048x1080                                        | 4096x2160                                        | 16384x8192                   |
| Quality Layer     | 1                              | 1                              | 2                                                | 2                                                | <=5                          |
| Components        | 3                              | 3                              | 3                                                | 3                                                | <=8                          |
| Bitrate           | <=250MBit                      | <=250 MBit/s                   | <=250MBit/s for Layer0<br><=500MBit/s for Layer1 | <=250MBit/s for Layer0<br><=500MBit/s for Layer1 | Lossy and lossless           |
| <b>Purpose</b>    | <b>DCP</b>                     | <b>DCP</b>                     | <b>IAP<br/>(compatible with Profile 3)</b>       | <b>IAP<br/>(compatible with Profile 4)</b>       | <b>MAP</b>                   |

- **Intermediate Access Package**  
**Data Organization for Efficient Access**

2k scalable  
Archive Profile  
File



4k scalable  
Archive Profile  
File

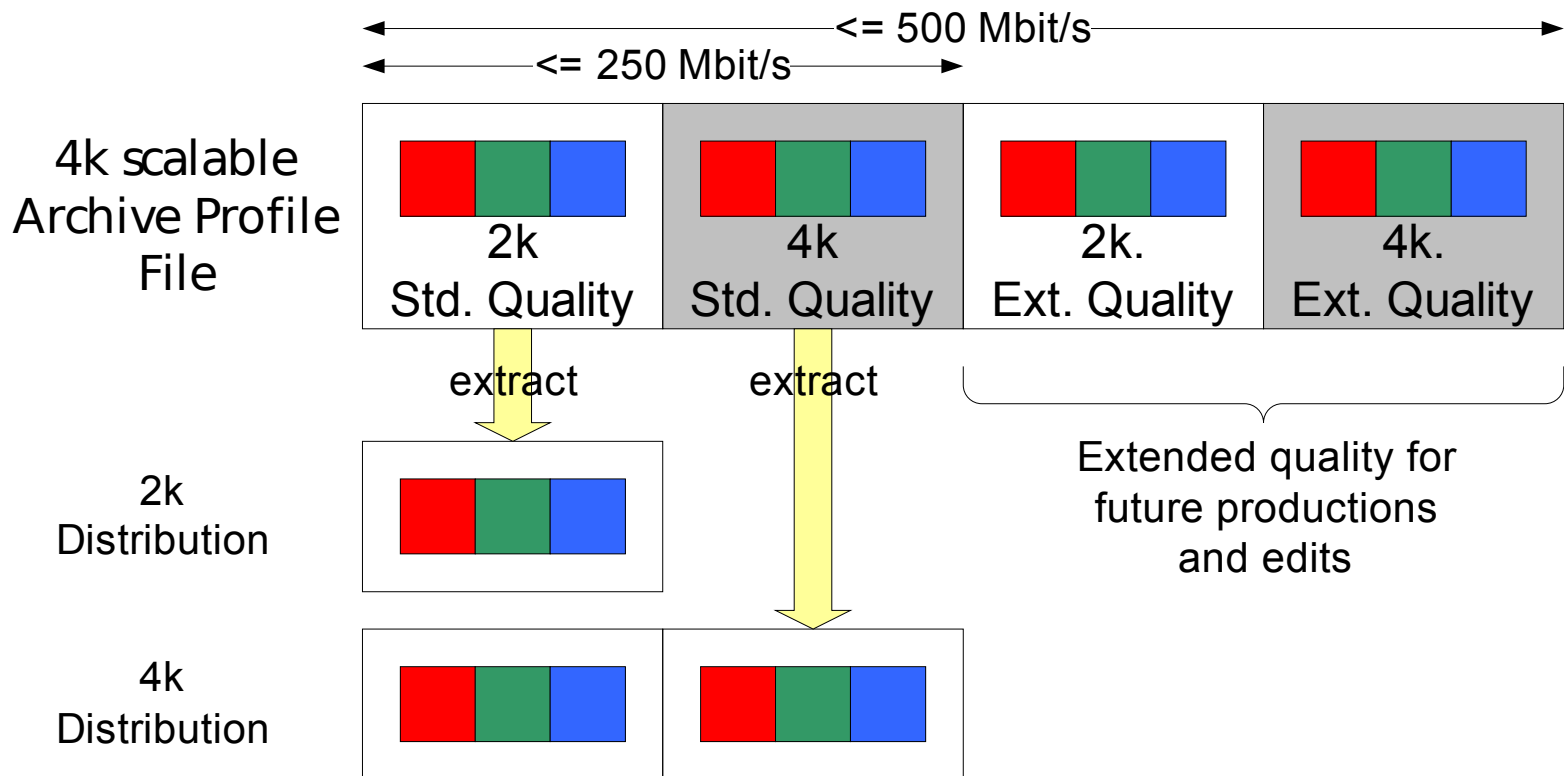


- Structured storage of image data
- Different parts are easily accessible
- Different usage scenarios

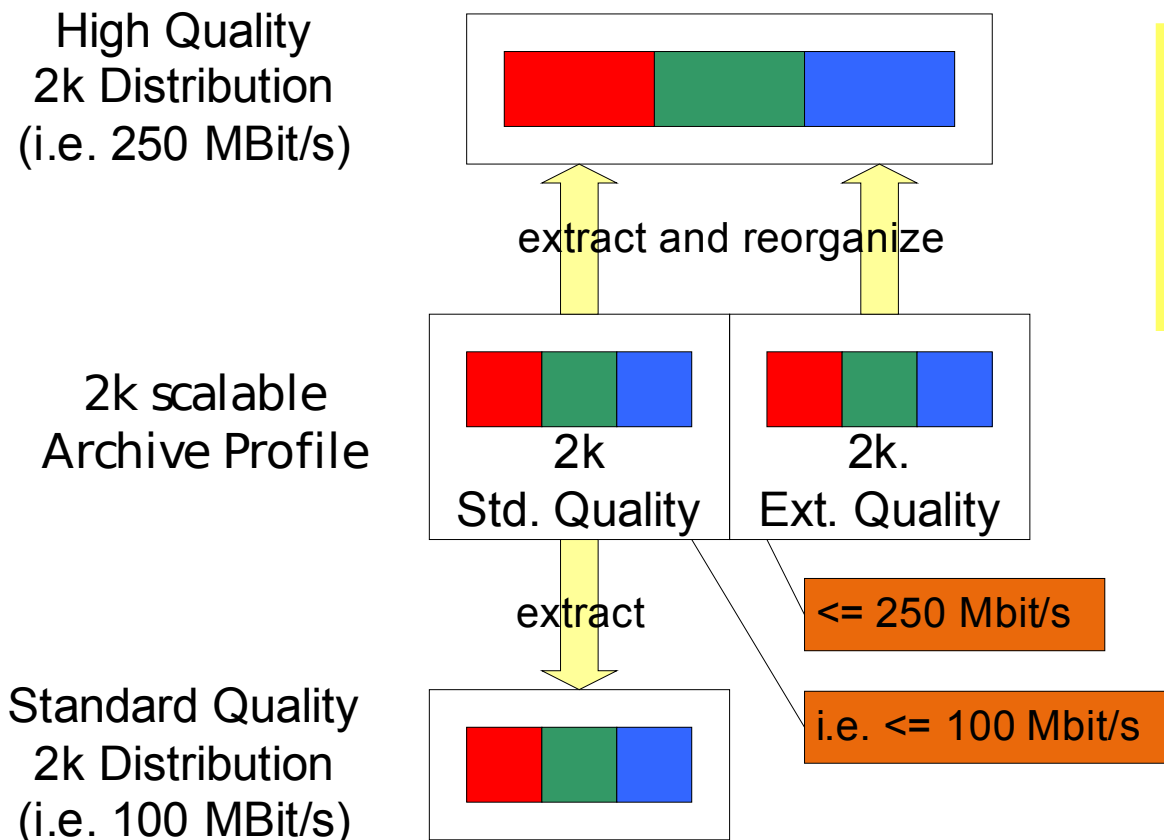


- # Intermediate Access Package

## Usage Scenario 1



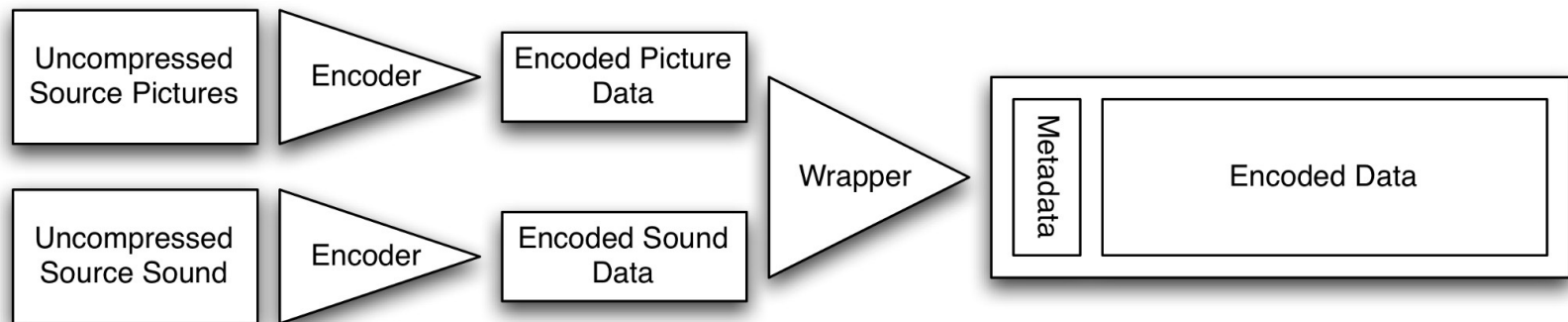
- **Intermediate Access Package**  
**Usage Scenario 2**



- No re-encoding necessary
- Similar principles possible for 4k

- **Metadata & Packaging / Wrapping Principles**

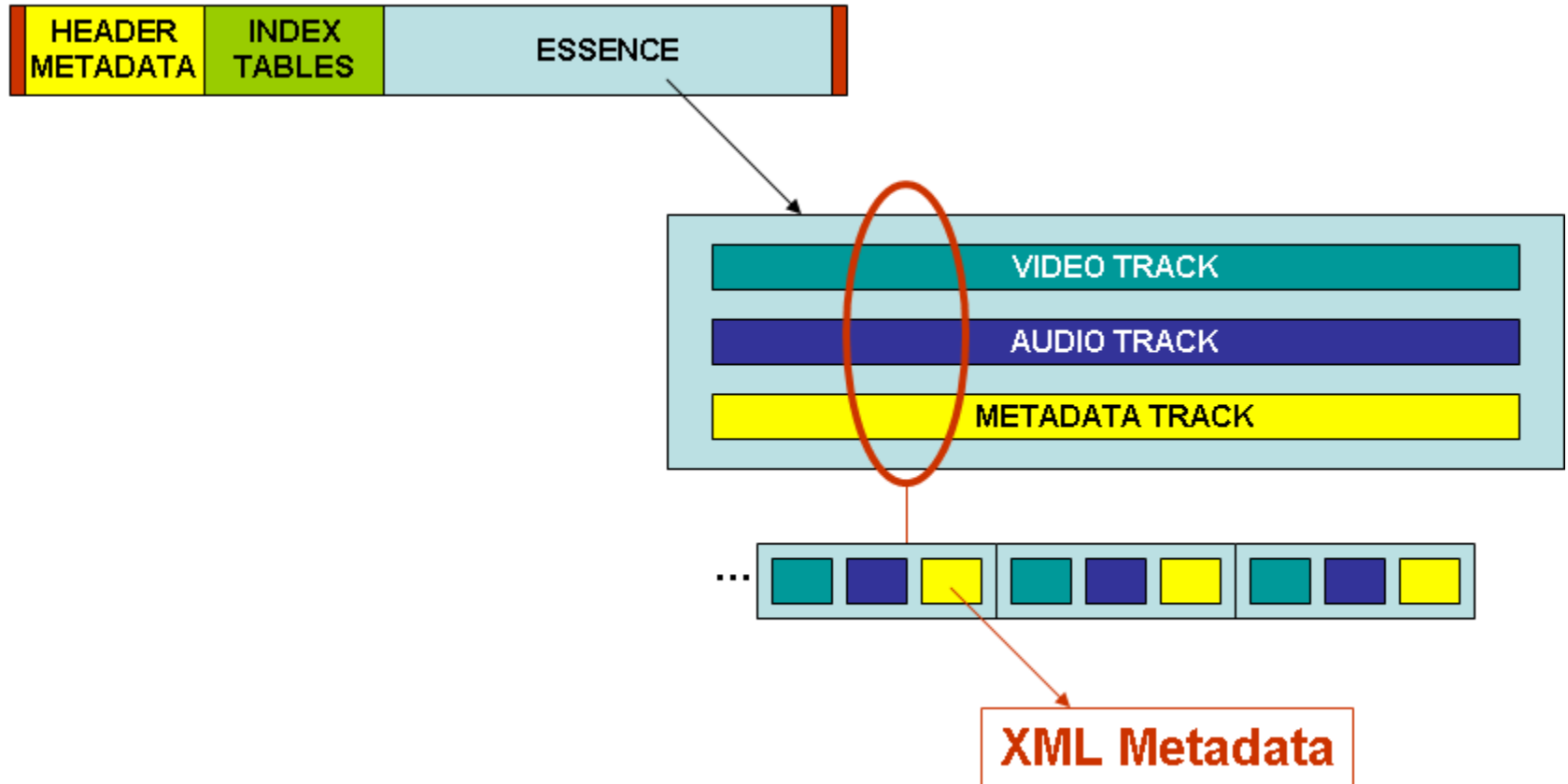
- Stream of compressed JPEG 2000 images
- Audio data
- Meta data
  - Additional information required for decoding (i.e. frame rates)
  - Descriptive data
- Synchronization necessary



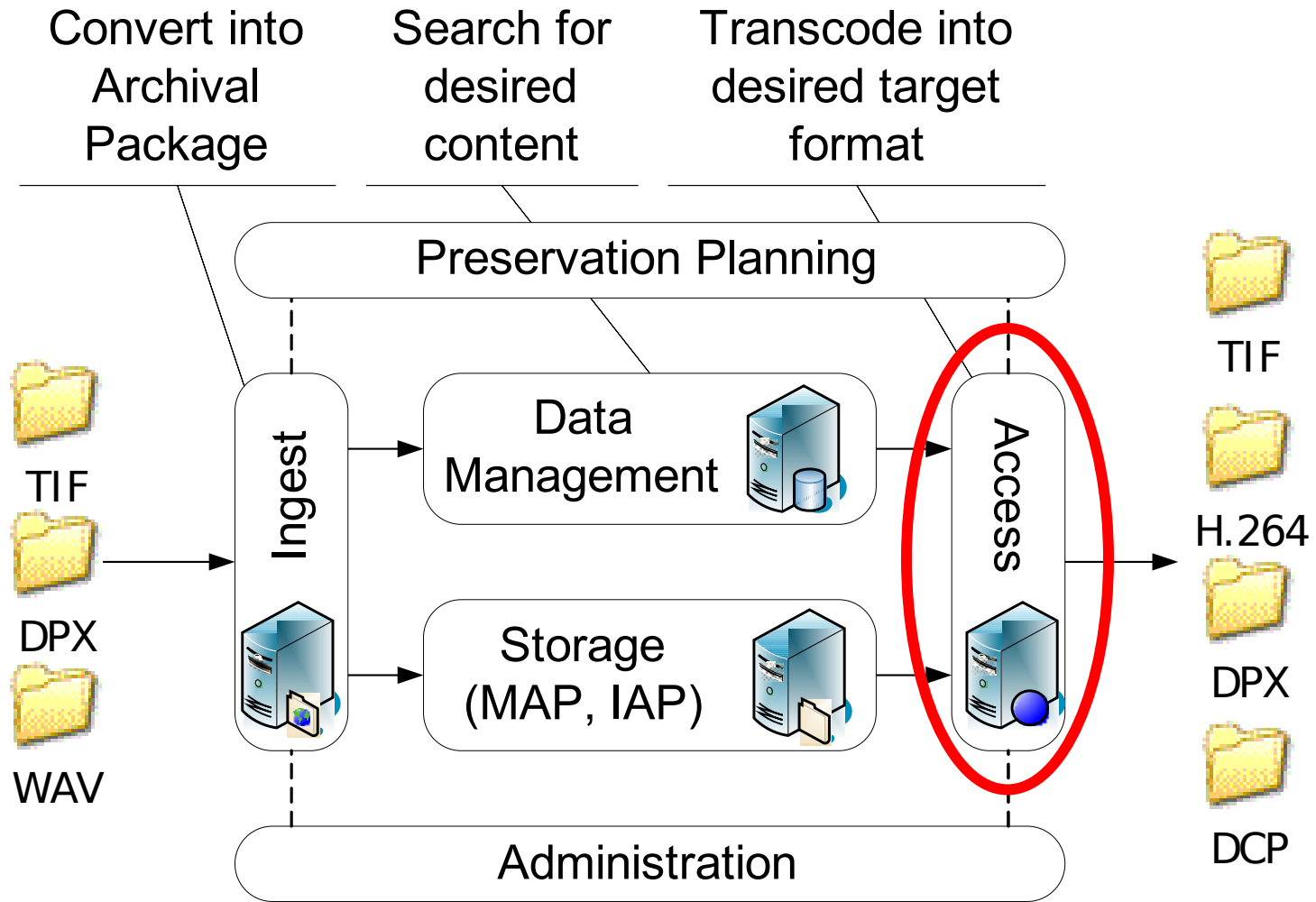
- **Metadata & Packaging / Wrapping**  
**Application for Archival**

- Material Exchange Format MXF
  - Wrapping format for essence & metadata
  - SMPTE standard
- Asset store: everything in one MXF file
  - Images
  - Audio (multiple languages and channels)
  - Metadata (descriptive, technical and historical)
  - Everything that belongs together is stored together
  - Easier mirroring and migration

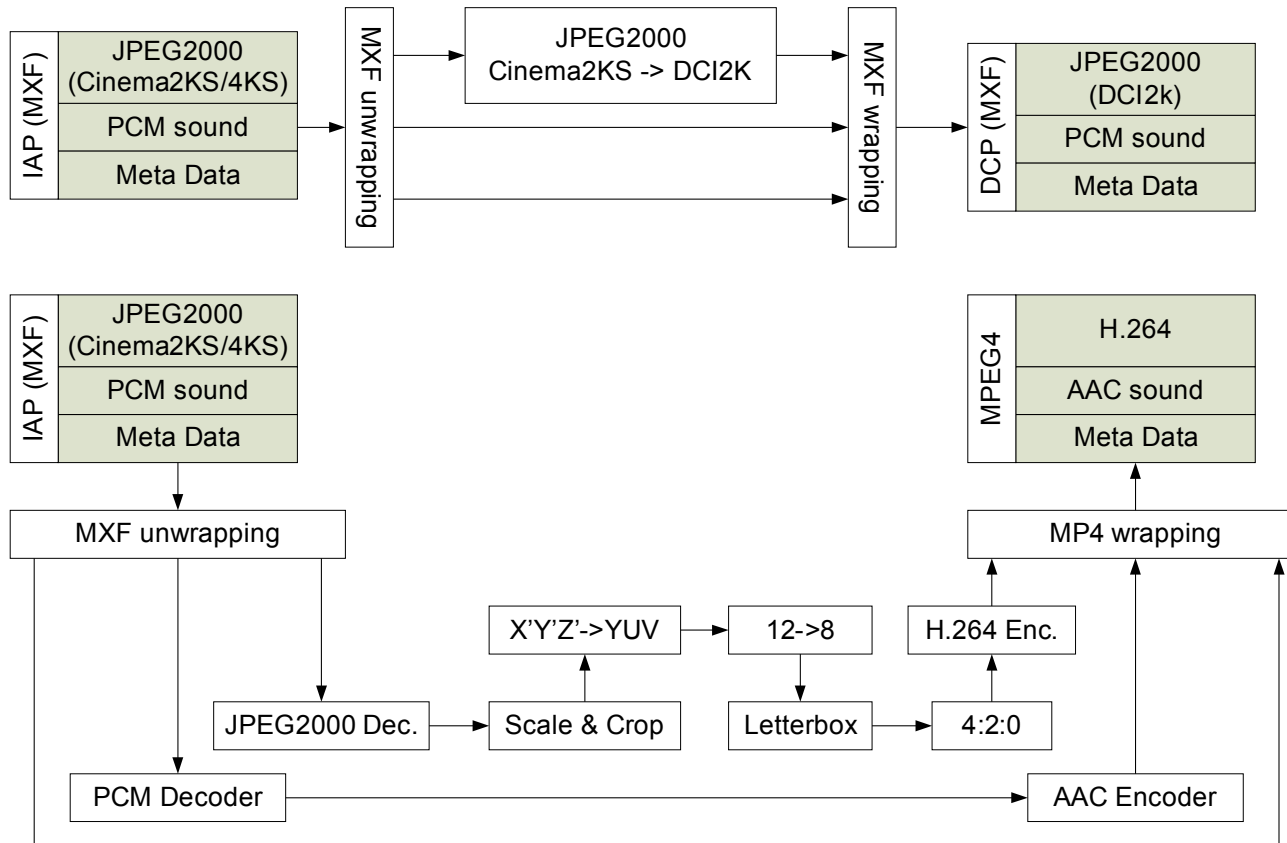
- **Metadata & Packaging / Wrapping**  
**Archival Packages**



# 1. Demonstrator System

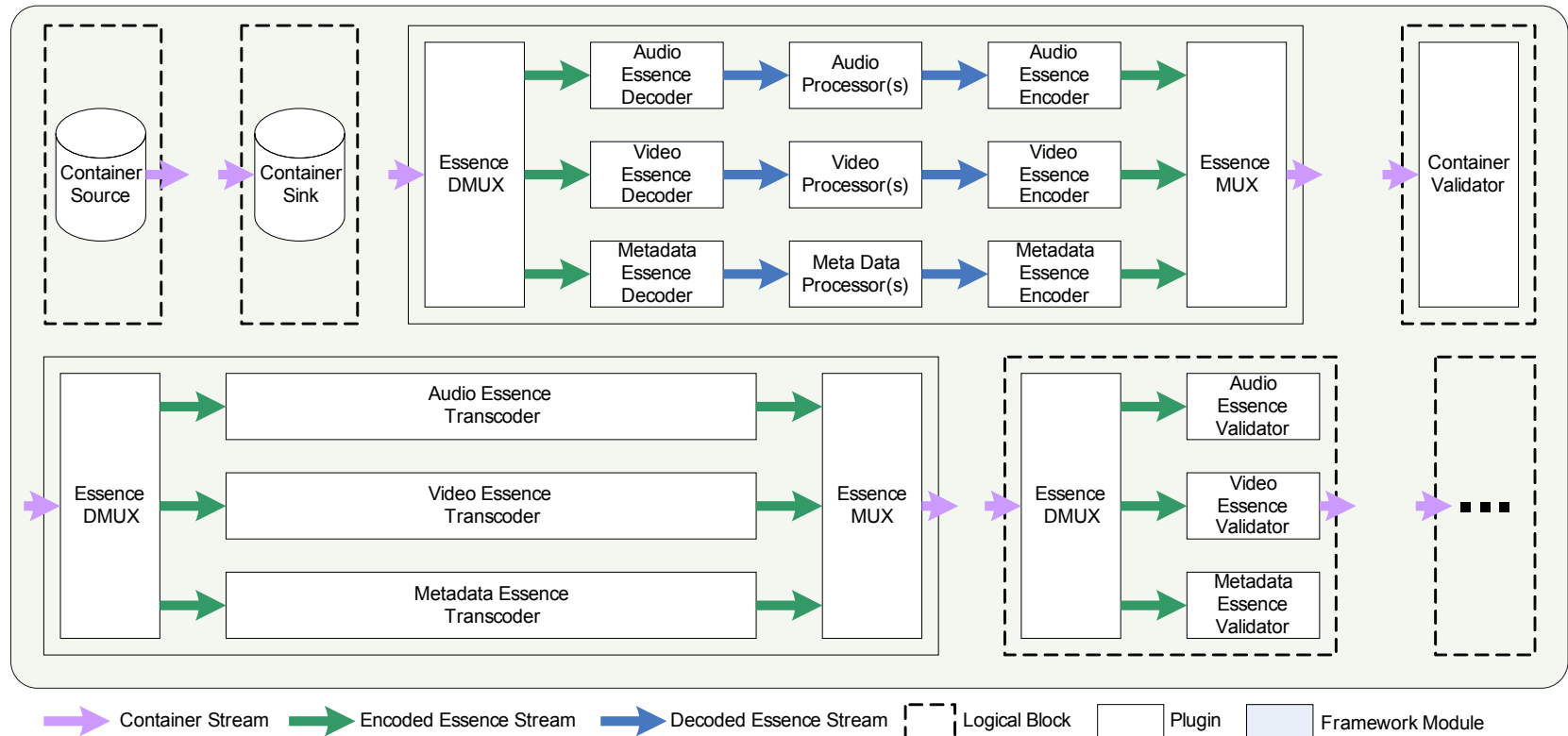


- # Demonstrator System Distribution



- # Demonstrator System

## Modular Approach





- **Demonstrator System**  
**The Prototype**



- # Demonstrator System

## Database Interface

The screenshot displays the Digital Film Archive (ED-CINE) web interface. The browser address bar shows `http://ux1040:8080/ol/ui/`. The page header includes the ED-CINE logo, the title "Digital Film Archive", and login fields for "E-mail address" and "Password" with a "Sign in" button. Navigation tabs include "Archive Home", "Search Archive", and "Browse".

The "Browse" tab is active, showing a list of items. The selected item is "Big Buck Bunny", with a thumbnail image and a "Preview" button. The item details are as follows:

- directed by**: Goedegebure, Sacha
- Country**: Netherlands
- Year**: 2008
- Runtime**: 10 min
- Genre**: Animation
- Source**: EDCine DFA

Below the details is the "Abstract & keywords" section:

- Abstract**: The plot follows a day of the life of Big Buck Bunny when he meets three bullying rodents, Frank, Rinky and Gamera. The rodents amuse themselves by harassing helpless creatures of the forest by throwing fruits, nuts and rocks at them. After the deaths of two of Bunny's favorite butterflies, and an offensive attack on Bunny himself, Bunny sets aside his gentle nature and orchestrates a complex plan for revenge.
- Keywords**: Rope Jumping, Animal, Bunny

At the bottom of the item page are expandable sections: "Cast & crew", "Miscellaneous", and "Available formats & prices".

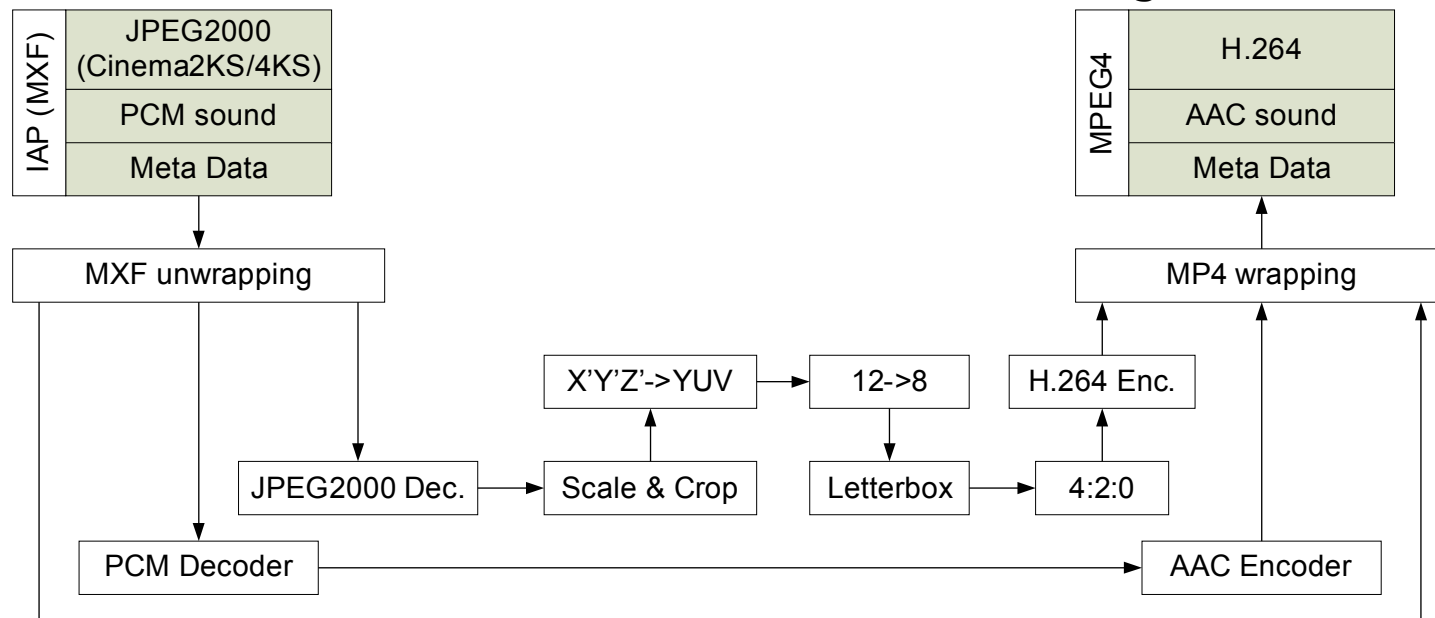
On the right side, a video player window titled "Big Buck Bunny - BBB320.mov - Mozilla Fi..." is open, showing the video at the 00:00:28 mark of a 00:09:57 duration. The player interface includes a progress bar, a "Fertig" (Finished) button, and a language selector set to "de-DE".

# 1. Conclusion

- Archiving of digital information is a predominant problem to solve
  - Nevertheless, its application is only at the very beginning
- JPEG 2000 defines an open, royalty and proven file format applicable to archival of image content
  - Different profiles depending on requirements and use cases
  - Scalability for extraction of different resolutions and qualities
  - Efficient generation of distribution formats, particularly DCPs
- MXF packing combines image, audio and meta data for simple management and migration
- First implementations available

- **Is everything done ... ?**  
**Universal Archival Package**

- Generation of dissemination format requires multiple processing steps
- Processing chains are configured by user
- Goal: Automatic, meta data controlled transcoding





# Thanks for your attention!

The EDCine – Enhanced Digital Cinema Project has been founded by the European Union in the FP6 program.

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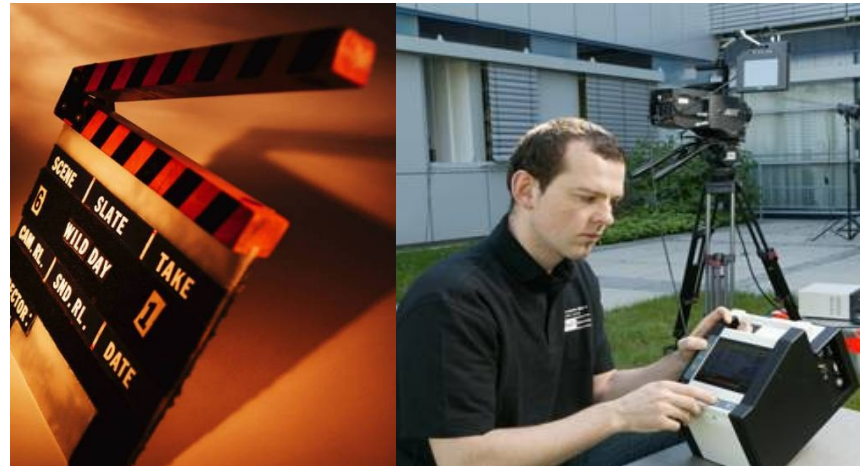
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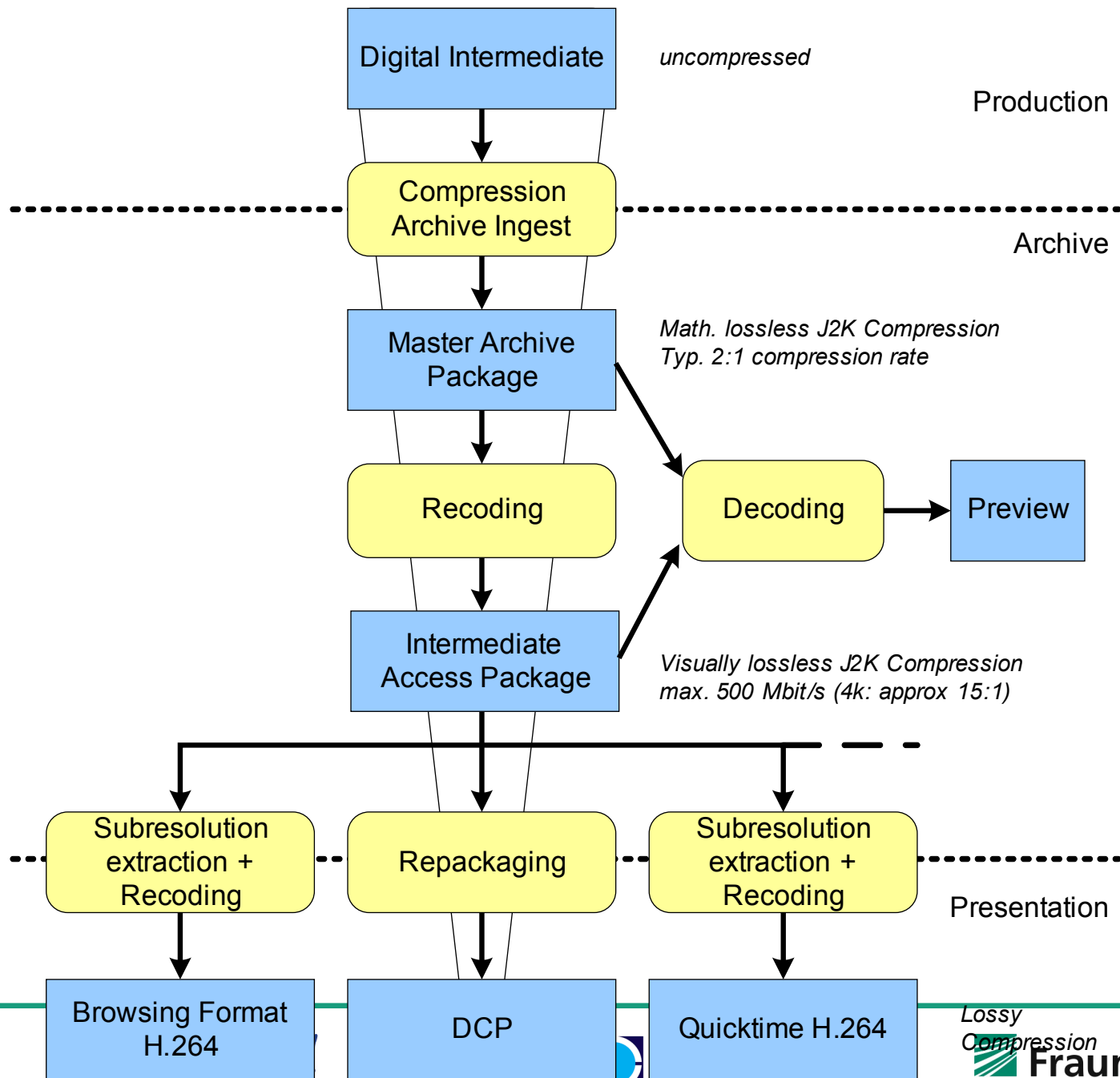
Complementary Information

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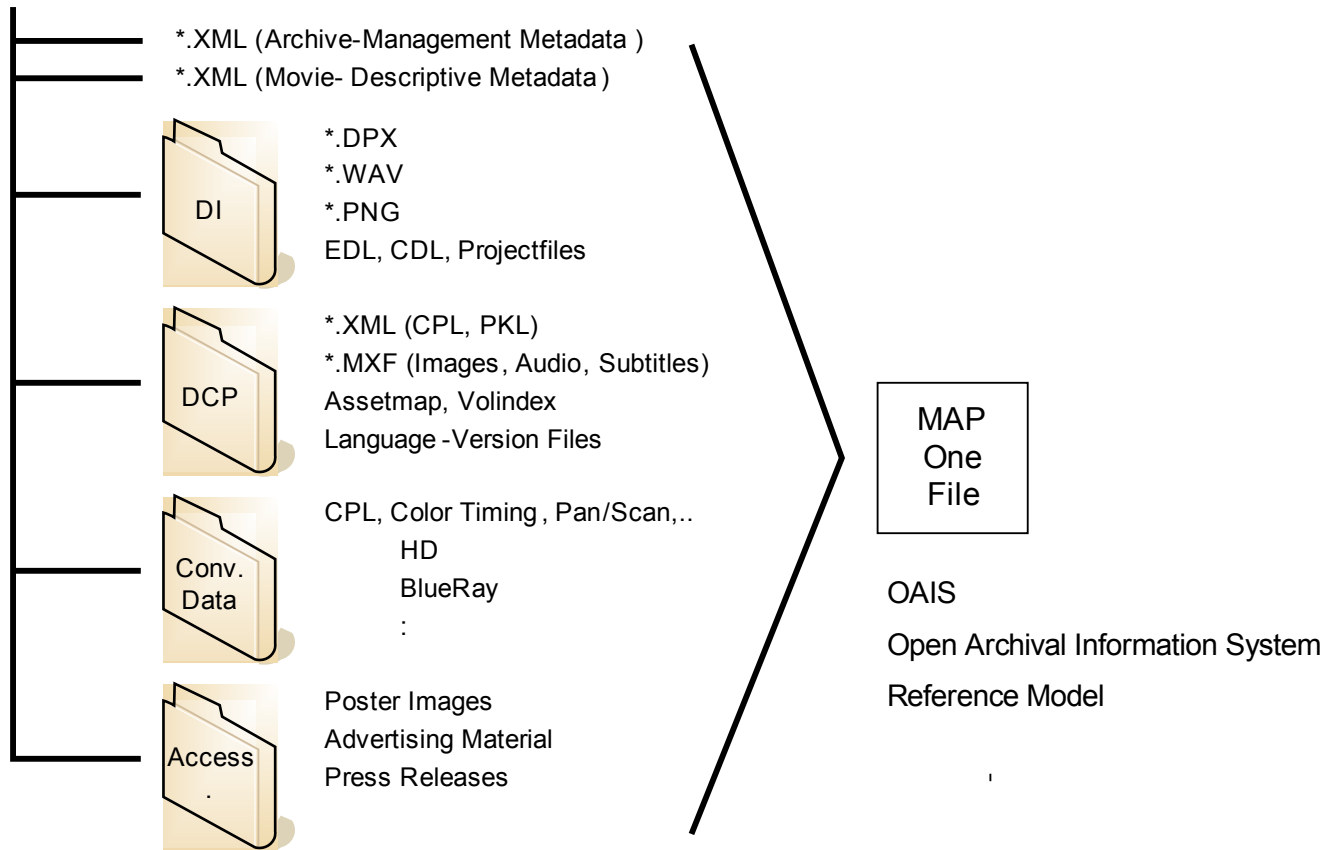
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- **Archive Package Usage Scenarios**  
**Master Archive Package**





- **Archive Package Usage Scenarios**  
**Intermediate Access Package**

