




**Layered Compression Technologies
for Digital Cinematography
and Cross Media Conversion**

Motivation

- Optimized workflow for the complete production chain for Digital Cinema in 4k does not exist
- DCI specification does not deal with production (only deals with the backend of the chain)
- Digital Cinema is a chance for the European film industry
- It requires an international consortium to solve the fundamental issues together

Project Overview Worldscreen™

- Objective: Investigation of the use of scalable video coding in digital cinema workflows
- Duration: 09/2004 – 04/2007
- Partners: 6 + 2 advisory (ARRI, Warner Bros.)
- Project Coordinator:

Fraunhofer Institut
Integrierte Schaltungen
- Budget: 6 Mio. €, Funding: 3 Mio. €
- Funded by the European Community (6th Framework)
- Website: <http://www.worldscreen.org>

world screen

Project Partners



Fraunhofer
Institut
Integrierte Schaltungen



Managementberatung
für
Medieninvestitionen

FLYING EYE



Fraunhofer
Institut
Nachrichtentechnik
Heinrich-Hertz-Institut

Kodak
Digital Cinema

T Systems



A Research Project in the 6th
Framework of the European
Community



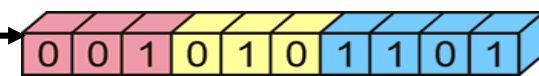
15 Feb 07

Scalable Video Coding

For acquisition,
postproduction,
distribution and
archiving



Encoding

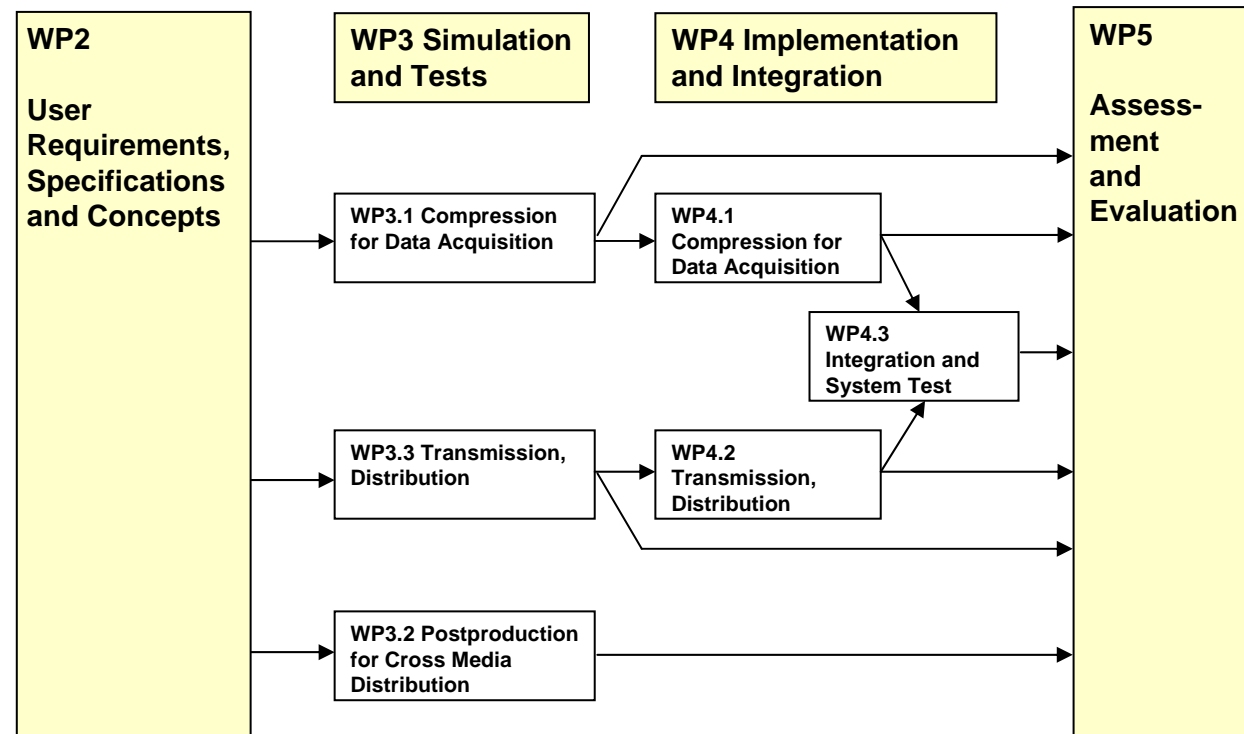


Scalable
Bitstream

SNR
Scalability

Spatial
Scalability

Technical Workpackages



Project Details

Layered scheme data compression in Digital Cinema workflows

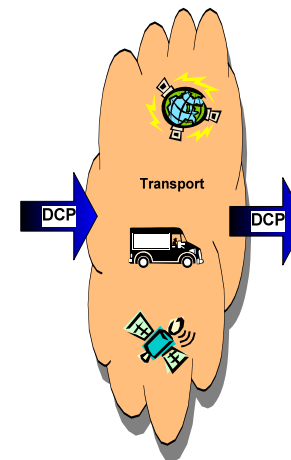
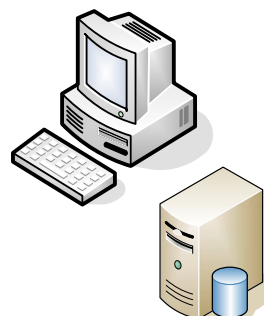
User Requirements
Business Models

Acquisition

Postproduction

Distribution

Exhibition



JPEG2000-
Encoder
Fieldrecorder

Use of Scalability
for processing /
for output to target
formats

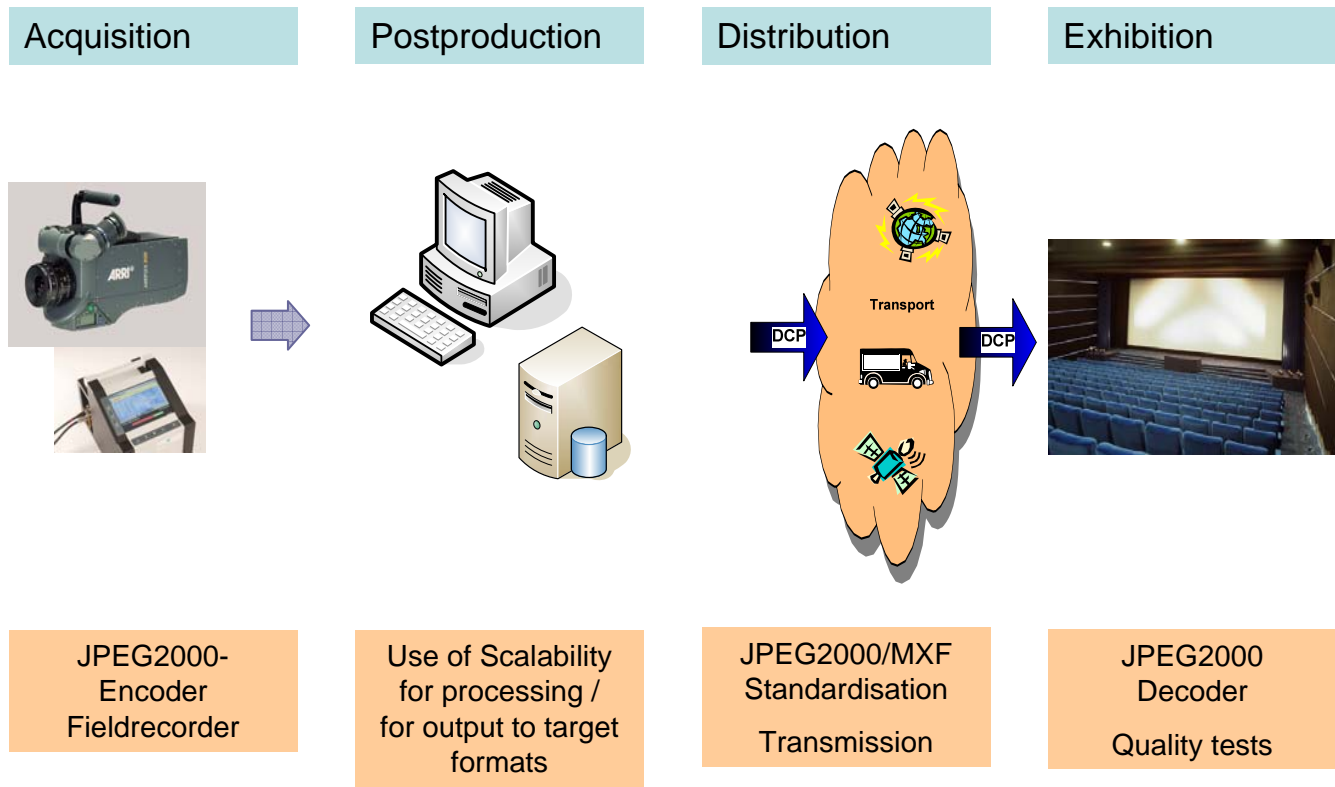
JPEG2000/MXF
Standardisation
Transmission

JPEG2000
Decoder
Quality tests

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Layered scheme data compression in Digital Cinema workflows



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Layered scheme data compression in Digital Cinema workflows

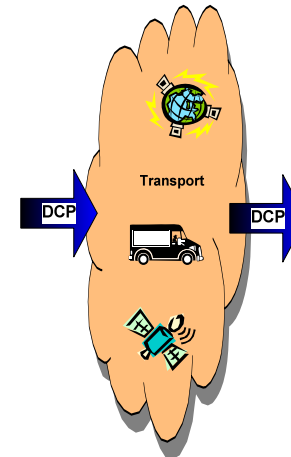
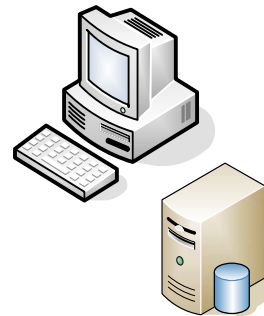


Acquisition

Postproduction

Distribution

Exhibition



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Project Achievements

- Developed workflow and metadata models for the entire production chain with LSC
- Developed a field recorder for providing a portable storage solution for future D-Cinema cameras including a JPEG2000 encoder
- Developed postproduction and transcoding methods (e.g. for (HD-)DVD, TV, streaming formats) from LSC master
- Developed scalable distribution and decoding systems (DCI compliant)
- Developed a quality assessment methodology for Digital Cinema
- Supported research and standardization of layered scheme data compression (both intra and inter) for D-Cinema



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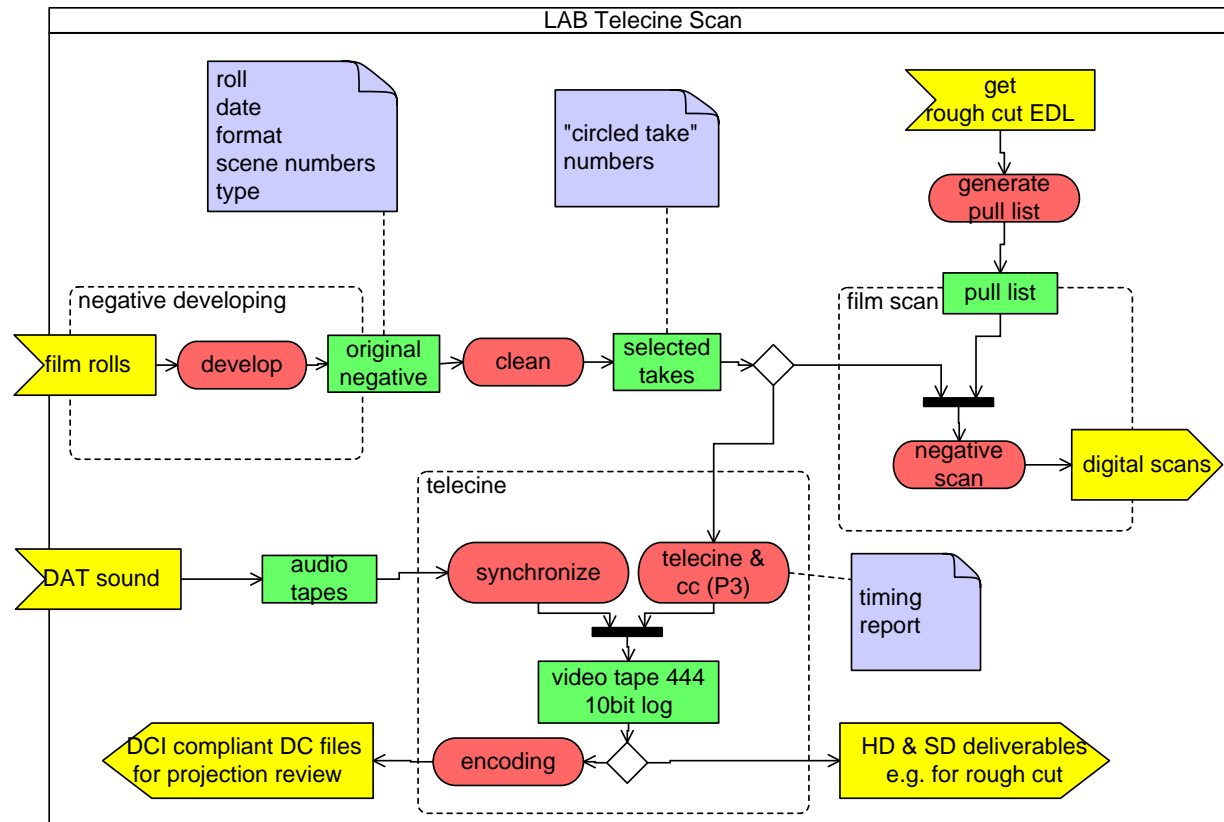
Information Society
Technologies

Goals – Methodology - Results

- The investigation of the use of layered scheme data compression throughout the entire DC chain and for rich media archives required:
 - Identification of user requirements
 - Specification of workflows and metadata models (current & future)
 - Evaluation of business models
- Methodology:
 - Interviews with 52 users and manufacturers
 - Structuring & Consolidation of market feedback
- Results
 - Deliverables with specifications for workflows and metadata
 - Deliverables covering cost comparisons and business models for the value chain

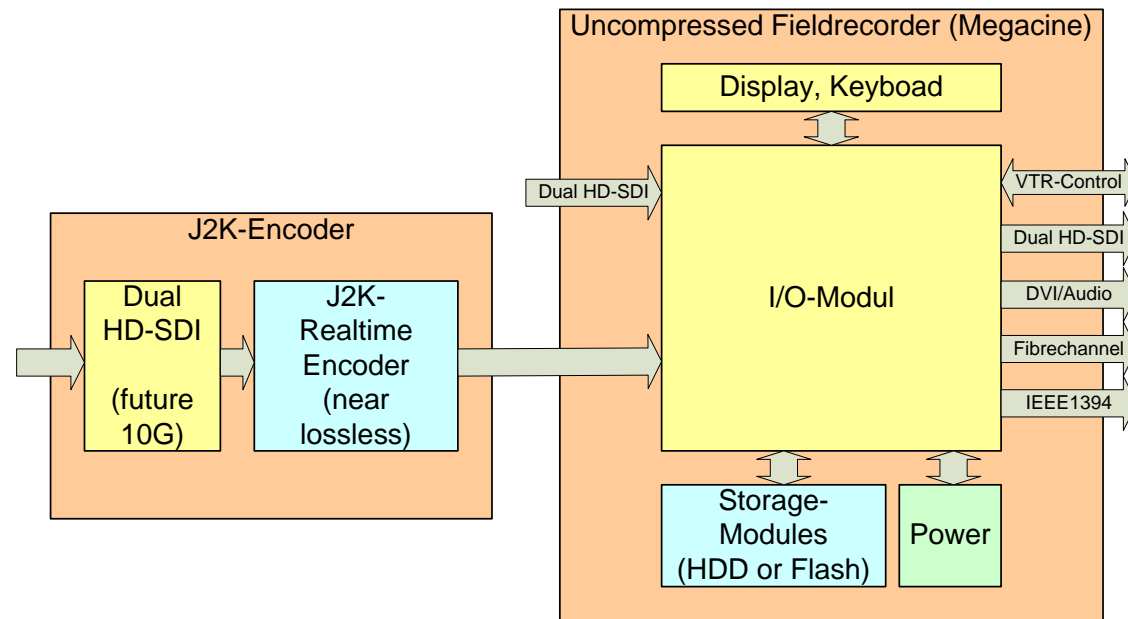
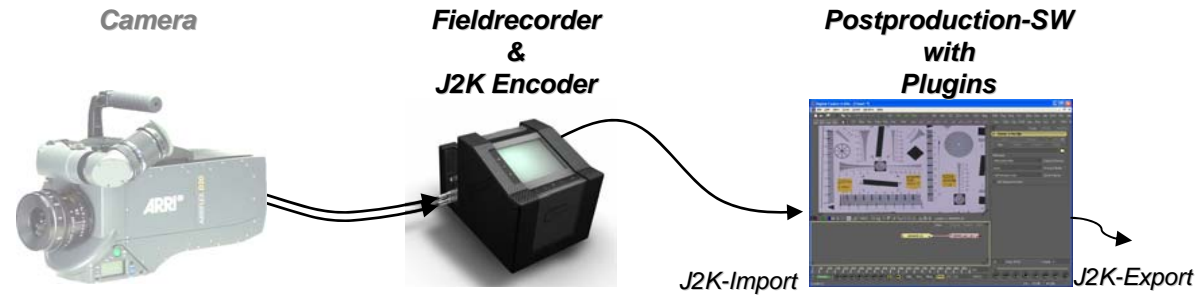
Activity Diagrams

Digital Intermediate Post Production

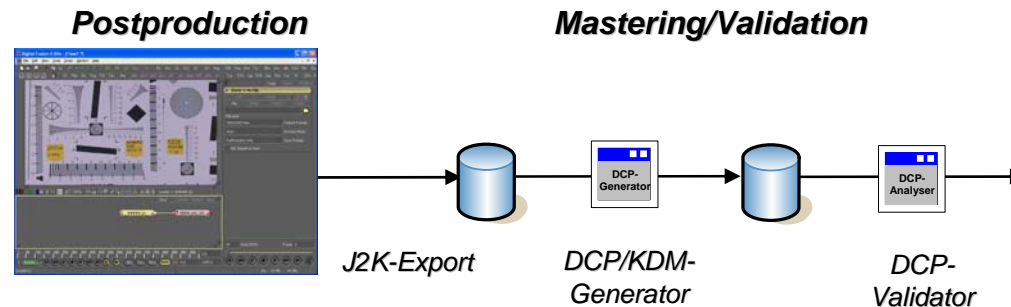


UML activity diagrams were extracted from the information from the interviews – these formally describe the most typical workflows.

Acquisition with JPEG2000 (J2K)



JPEG2000 Workflow



- Development of Softwaretools for JPEG2000
 - Input/Output-Plugins for Digitalfusion
 - DCP/KDM Generation Tools
 - DCP/KDM Validation Tools
- Concepts for Archives based on JPEG2000 (will be continued in EU-Project EDCINE)
- Future Need: J2K-Hardwaresupport in Postproduction

What is Transcoding all about?

- Conversion of theatrical content into entertainment video formats, e.g.:
 - SDTV (PAL, NTSC)
 - HDTV
 - Streaming video (internet, mobile)
 - etc.

Additional Sources
of Revenue

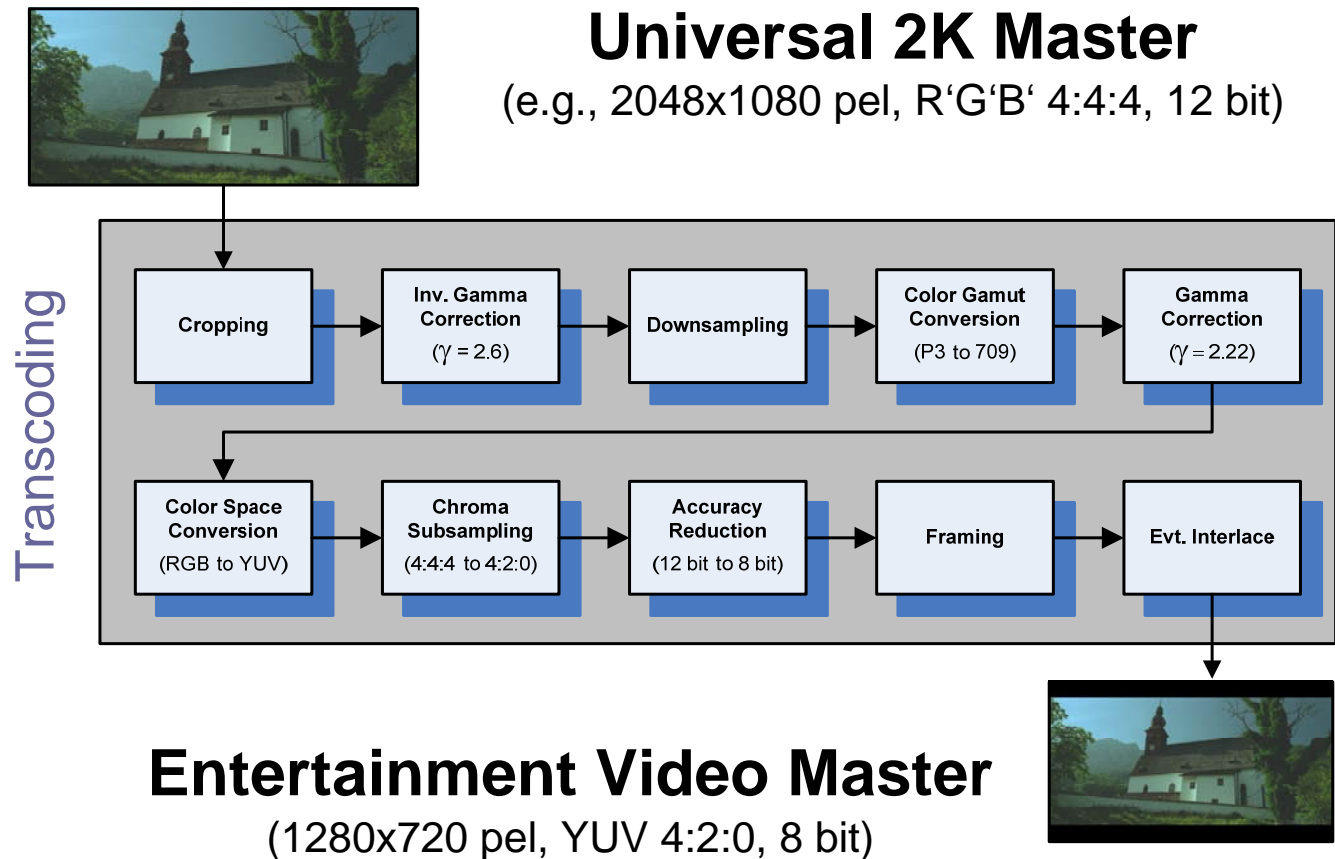


Theatrical Content

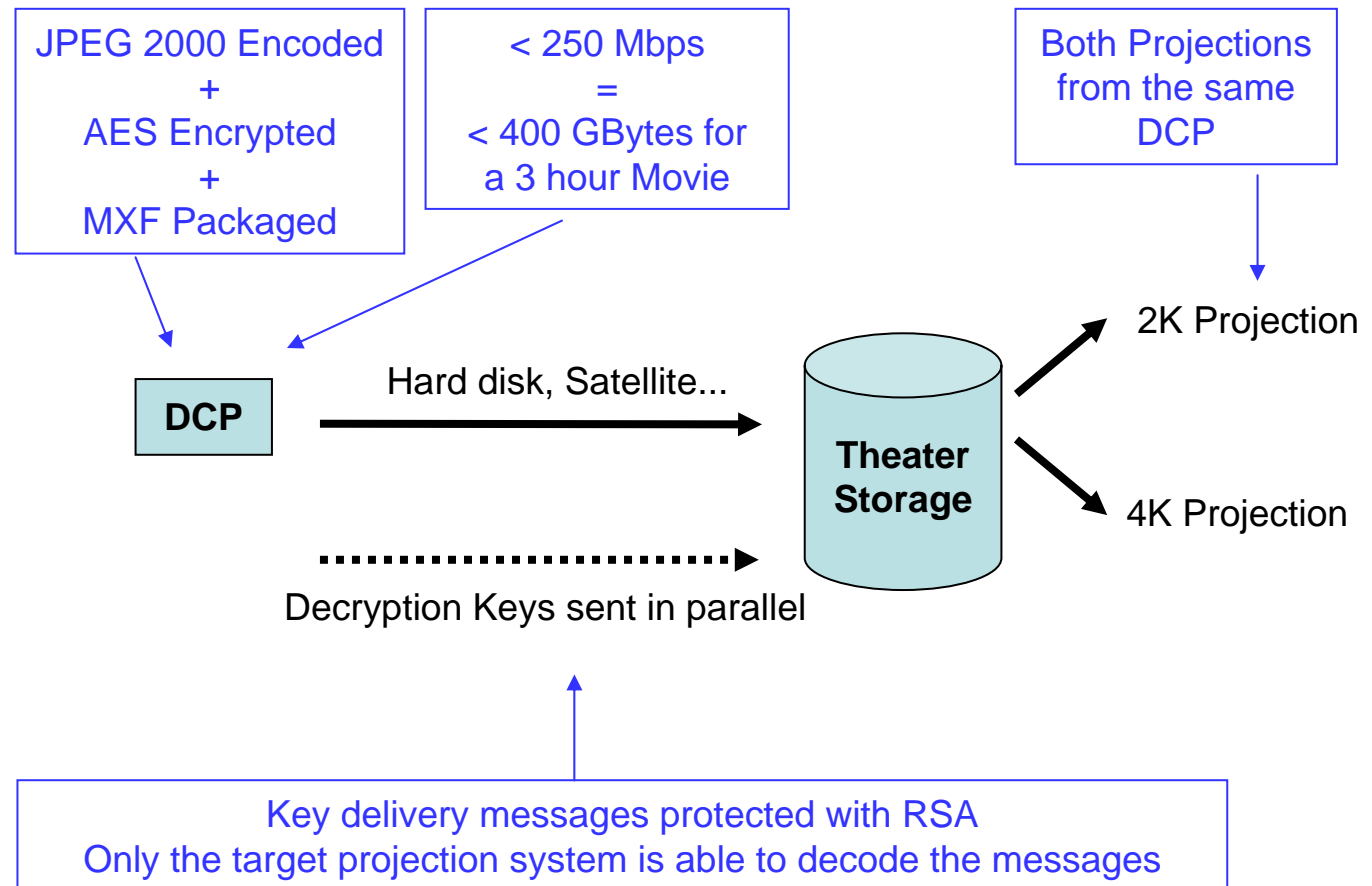


Entertainment Video

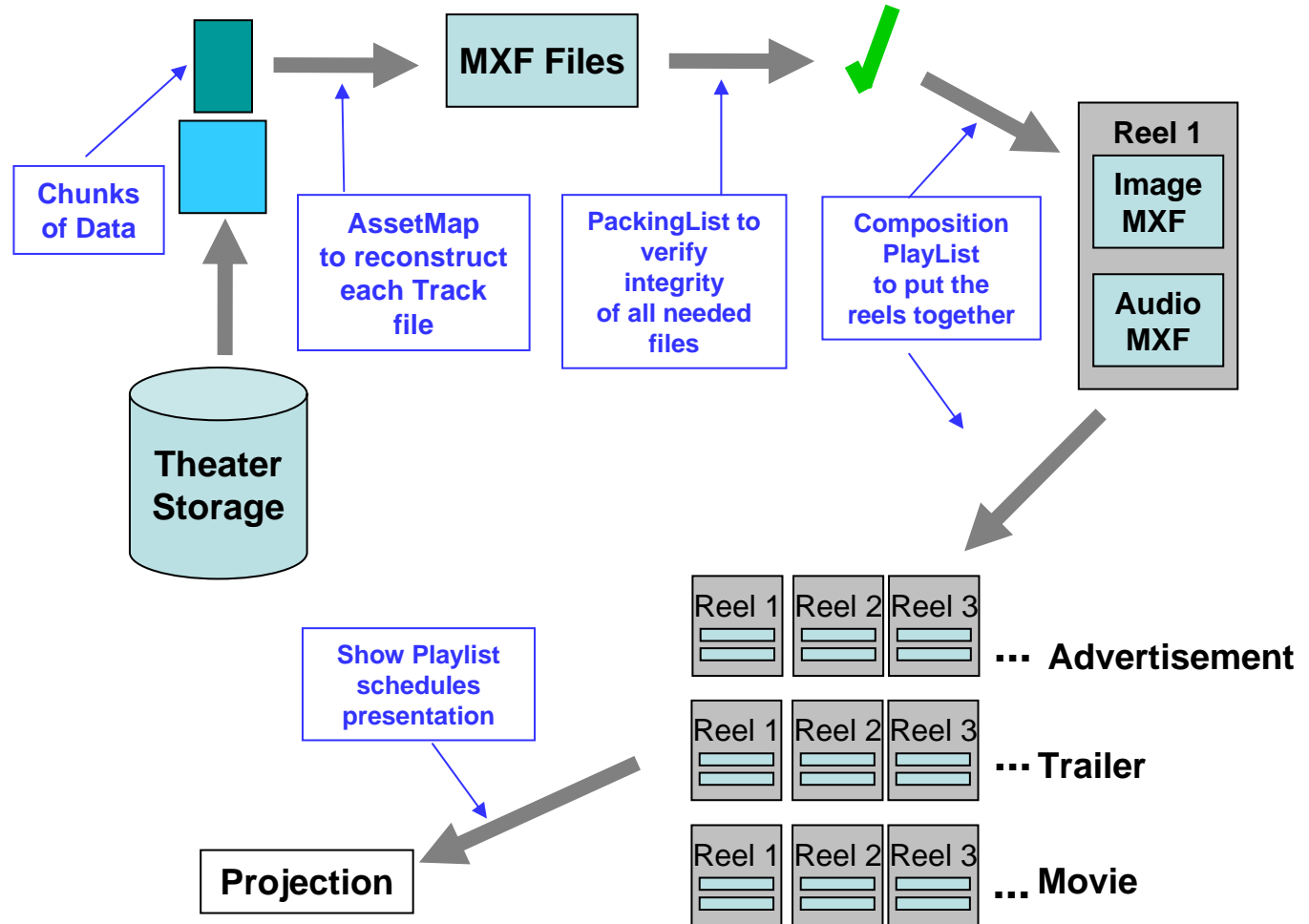
Transcoding Workflow – Example



Digital Cinema Packages – DCI Model



Digital Cinema Packages – DCI Model



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T...Systems...

powered by:

Deutsche Telekom
Laboratories **T**...

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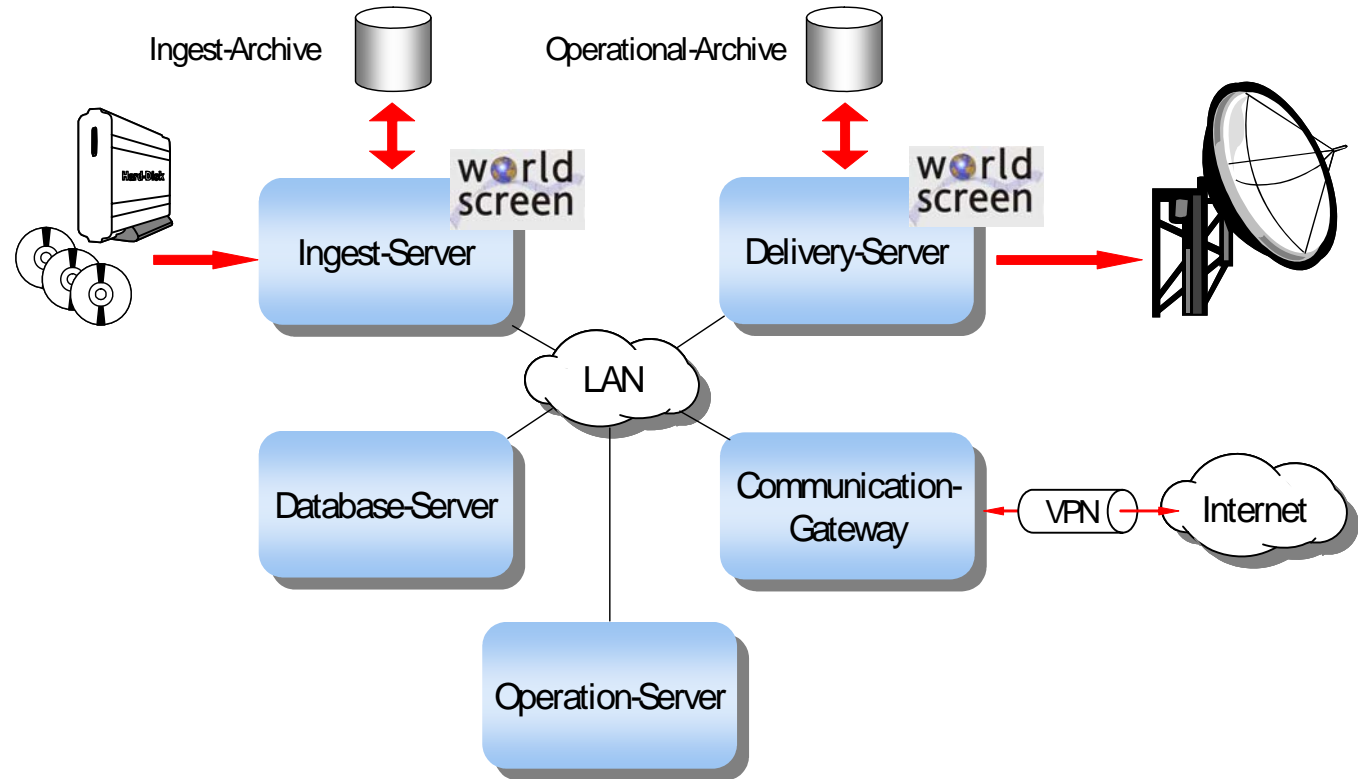
Deutsche Telekom @ WorldScreen

**T-Systems is a full service
provider for Digital Cinema**

**Digital Cinema Factory™:
Reliable delivery of Digital Cinema
Packages via satellite**

**Digital Cinema Feature Film™:
Server Solution for
Multiplex Theatres**

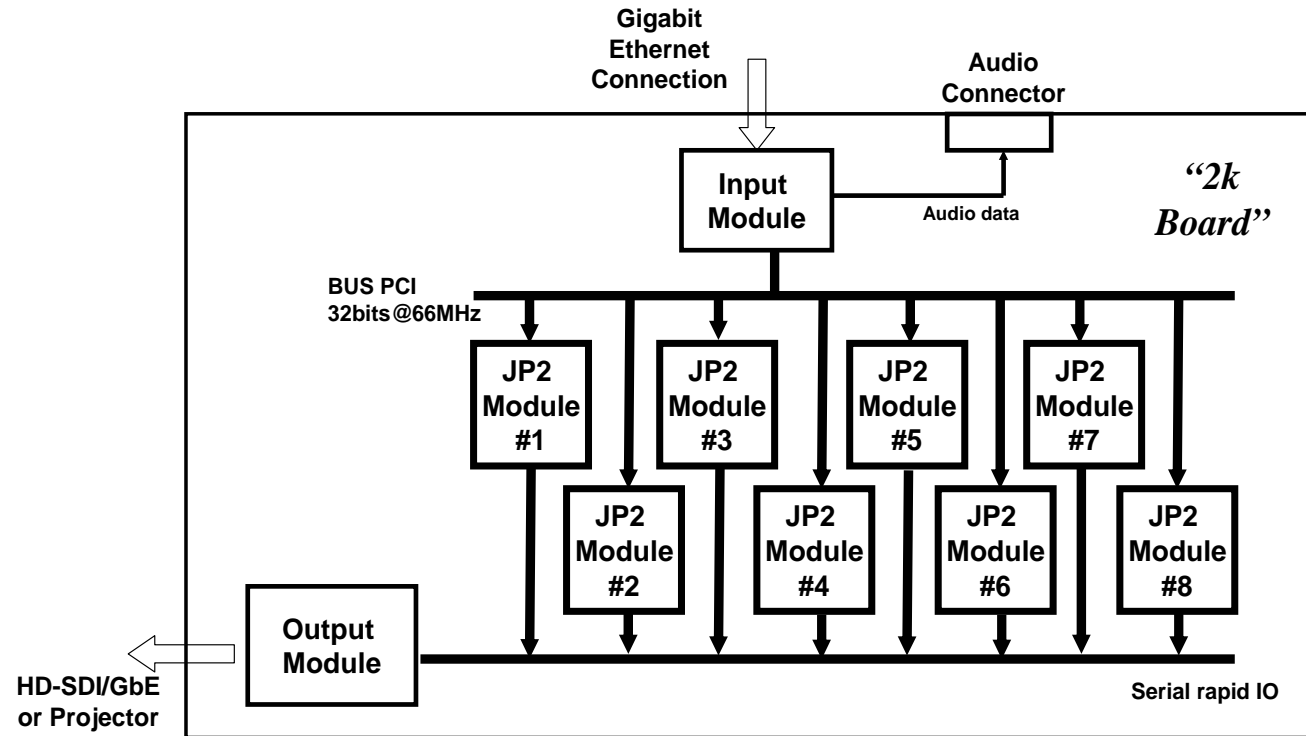
Deutsche Telekom @ WorldScreen



Digital Cinema Factory™

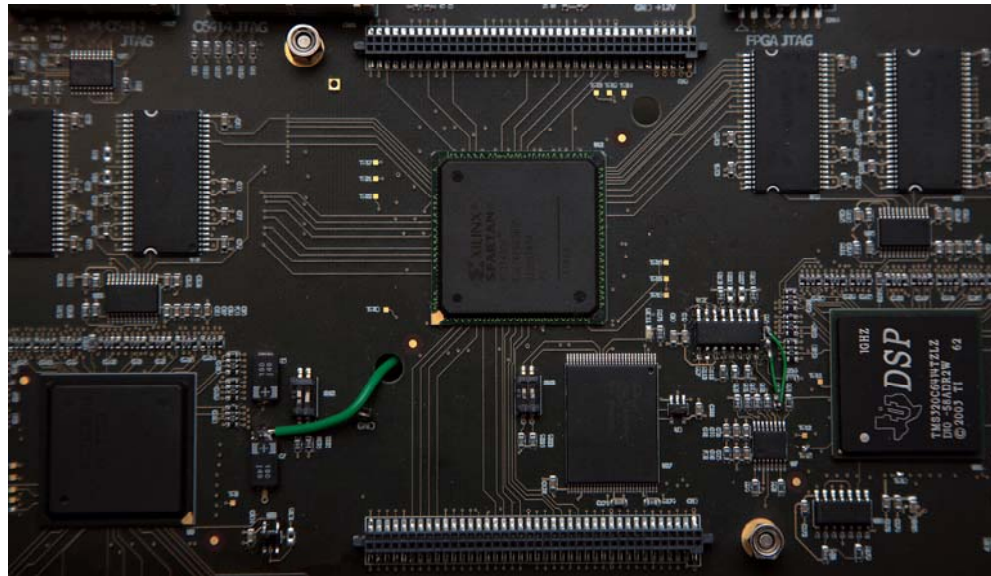
Within the WorldScreen project, software components for 4K DCP delivery have been developed, co-funded by the EC and the Deutsche Telekom Laboratories

J2K Decoder Architecture



This architecture must to be able to decode the 2K at 24fps, 2K at 48fps and 4K at 24fps profiles; for the 4K, or future higher profile, some parallel 2K-Boards will be necessary.

DSP-FPGA Coprocessor in the Decoder Chain



- FPGA performs bit-oriented operation on Tier 1 (computationally expensive) and Inverse Quantization.
- DSP completes the decoding chain, performing IDWT on large images.
- FPGA acts as coprocessor for DSP, in a loosely coupled architecture.

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Kodak
Digital Cinema

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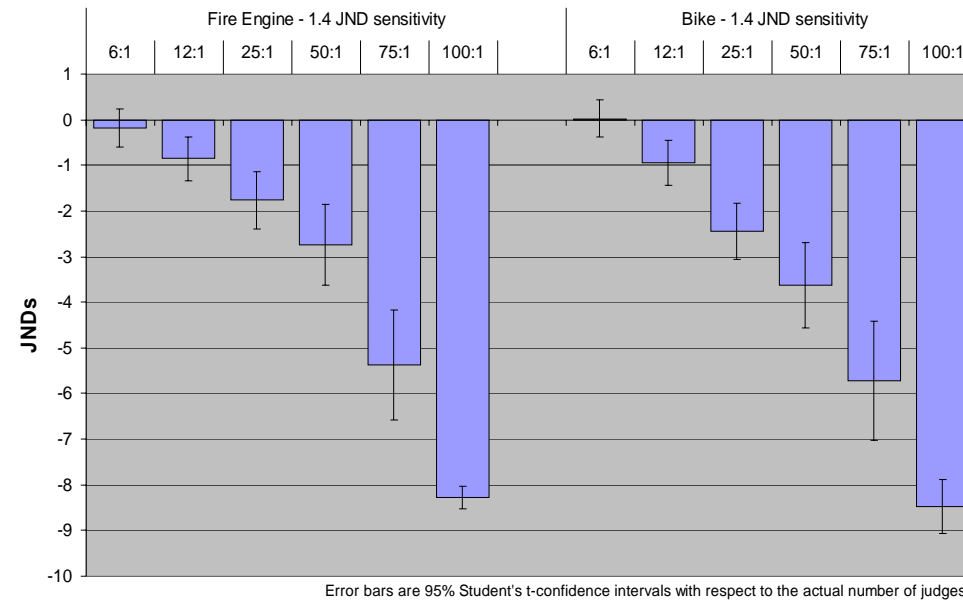
Image Quality Assessment

Kodak Digital Cinema stands for highest image quality,
analog **AND** digital

- Multi-format Cineserver JMN3000 with 3D support
 - Digital Processing / Delivery of over 40 full feature films
 - Comprehensive Theater Management System
 - Over 2100 pre-show advertising systems installed
- Motion Quality Ruler (MQR) is a new method for assessing image quality of motion sequences
 - Can be used to judge wide quality range efficiently and precisely
 - MQR method was implemented and validated at a special Kodak test facility in Paris
 - MQRs were created for a wide range of scene content and origination sources that would be encountered in practice

Motion Quality Rulers

- MQRs were verified and subsequently applied to test scenes compressed with JPEG2000 at compression ratios of 6:1 to 100:1
- Results indicate feasibility to devise MQRs for individual scenes that can be used to judge quality degradation from compression over large quality range



Layered scheme data compression in Digital Cinema workflows

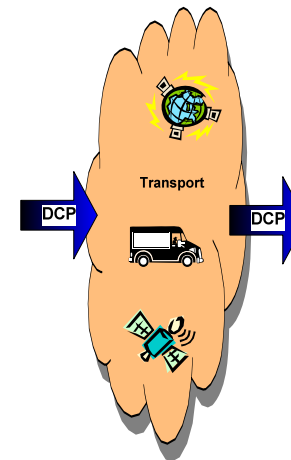
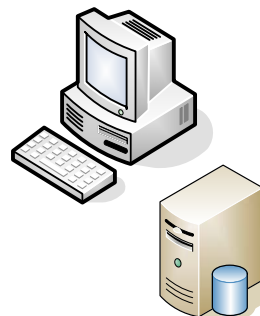
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Screening - Content

- **Advertising Clips**

- ZKM-Spot (ZKM)
- BMW X5 (BMW)
- Rimowa (Rimowa)

- **Trailer**

- Happy Feet (Warner Bros.)
- Harry Potter (Warner Bros.)
- We are Marshall (Warner Bros.)

- **Excerpts from Feature Films/Testmovies**

- Cool Hand Luke* (Warner Bros.)
- Ocean's 11* (Warner Bros.)
- As good as it gets (ARRI/Bill Benett)
- Mystic India (BAPS/Keith Melton)

* available on DVD

Screening - Technology

- **DCPs** (Digital Cinema Package)
 - generated and tested by Fraunhofer IIS
- **Players**
 - T-Systems Digital Cinema Feature Film™
 - KODAK JMN3000 Digital Cinema Server
- **4k Projector**
 - Sony SRX-R110