



WorldScreen

Layered Scheme Compression for the
Digital Cinema Chain

Mike Christmann

<http://www.worldscreen.org>

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



Project Overview

- Acronym: WorldScreen
- Duration: 09/2004 – 04/2007
- Partners: 8 + 2 associated
- Project coordinator: Fraunhofer IIS
- Partly funded by the European Community (6th Framework)

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



The Consortium



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



Edition Salzgeber



The Motivation

- An optimized workflow for the complete production chain for Digital Cinema in 4k does not exist.
- The DCI specification only deals with the backend of the chain, from the distribution master to the presentation in the theatre, not the production.
- Digital Cinema – in particular E-Cinema - is a chance for the European film industry.
- It requires an international consortium to solve together the fundamental issues.

Project Goals

- Investigate the use of a layered scheme data compression technology throughout the entire production chain.
- Investigate the use of layered scheme data compression for “rich media” archives.
- Develop a workflow and metadata model for the entire production chain.

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



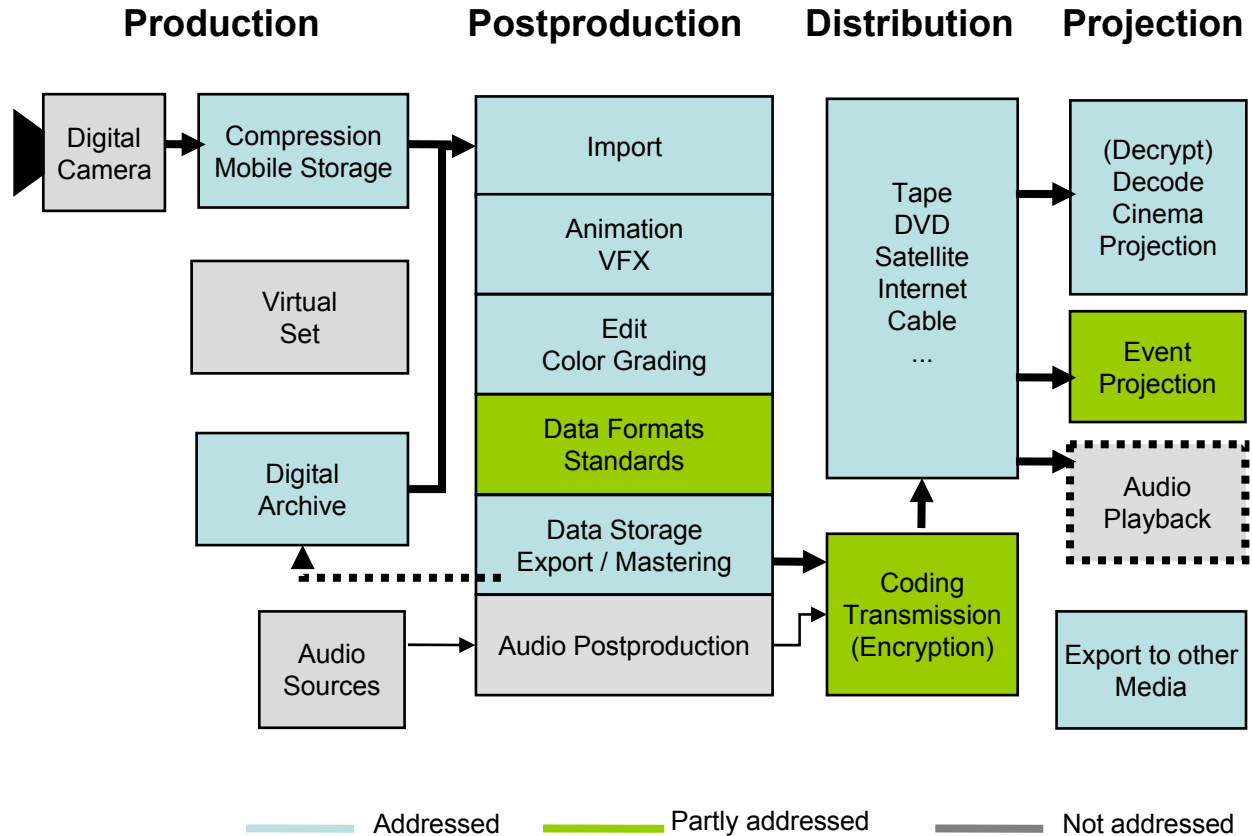
Project Goals

- Develop a quality assessment methodology for Digital Cinema.
- Try to standardize a production chain which will support both, D-Cinema and E-Cinema.
- Support the research and standardisation of layered scheme data compression.

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



Project Overview



Status of Feature Film Production

- Digital feature film production is just starting to take off.
- A complete economical digital workflow in 4k is not realistic without compression for some time.
- We would like to have access to different quality and resolution levels during the entire production process.
- Since we are just starting with this new paradigm should we not try to come up with a **holistic approach** rather than a **diversified approach** for these issues?

Based on J2K we will investigate how LSC can be used throughout the entire production chain. Furthermore we will try to enhance the standard (e.g. 3D Wavelets).

LSC During Acquisition

- Portable storage for 4k digital cinema cameras with lossless or near lossless layered data compression based on J2K will be investigated.
- A prototype field recorder based on a layered scheme compression technology for Digital Cinema will be specified and implemented.
- Investigation on mobility vs. compression efficiency.

Direct use in postproduction chain without the need to produce additional lower resolution versions.

Target Spec 4k Field Recorder

Max. Input Data Rate	500-600 MByte/s
Compression	Lossless or near lossless, layered and scalable
Max. Image Size	4096x3112 and 1920x1080 for SlowMo
Max. bit depth per color	12-16
Color Space	RGB 4:4:4 or raw format
Max. Weight	3 kg

LSC During Postproduction

- Evaluate layered scheme compression in the context of various postproduction environments.
- Come up with an architecture for a realtime 4k J2K decoder.
- Transcoding and workflow optimisation for cross media distribution
 - convert the layered production format to various distribution and storage formats:
 - MPEG-2, DVD
 - H.264/AVC
 - WM9 / VC1
 - Quicktime, Real Player

During postproduction, previews, editing, vfx or colour correction can be done instantaneously either using the full resolution OR a lower resolution layer of the SAME file.

LSC During Distribution

- We will develop a hardware based 4k real time decoder for J2K supporting various layers and quality levels.
- Implement and test a prototype LSC based distribution system.
- The distribution system will make use of MXF as a universal file format as a transport container following the DCI specification.
- J2K will be compared in particular to H.264/FRExt.

LSC During Distribution

- Specification of a network adoption layer
 - investigation related to the transmission of J2K via error-prone channels (e.g. satellite) using non reliable protocols such as UDP
 - a proper protection scheme for dealing with such an environment will be specified according to J2K Part 11 standard (JPWL) or at MXF level
- Integrated 2K/4K delivery to cinema theatres, to be optimised for point-to-point and point-to-multipoint scenarios (simulcast vs. layered distribution).
- Comparison and evaluation of electronic and physical distribution media

Digital film copies could be created in different resolutions on the fly from a single master format.

LSC for Digital Archiving

- Requirements and specifications for this application will be developed:
 - main categories are content archiving, archive retrieval and searching the archive.

For “rich media” archives, layered scheme compression offers the possibility of access to different resolutions and qualities without the need to hold different copies of the same image.

Workflow & Metadata

- Identify user requirements and specify workflows using layered compression in Digital Cinema and 'rich media archive' applications.
- Define a metadata model (dictionary & scheme) for the above applications.
- The intention is to establish a metadata dictionary for the entire digital production chain.

Metadata – the Tower of Babel

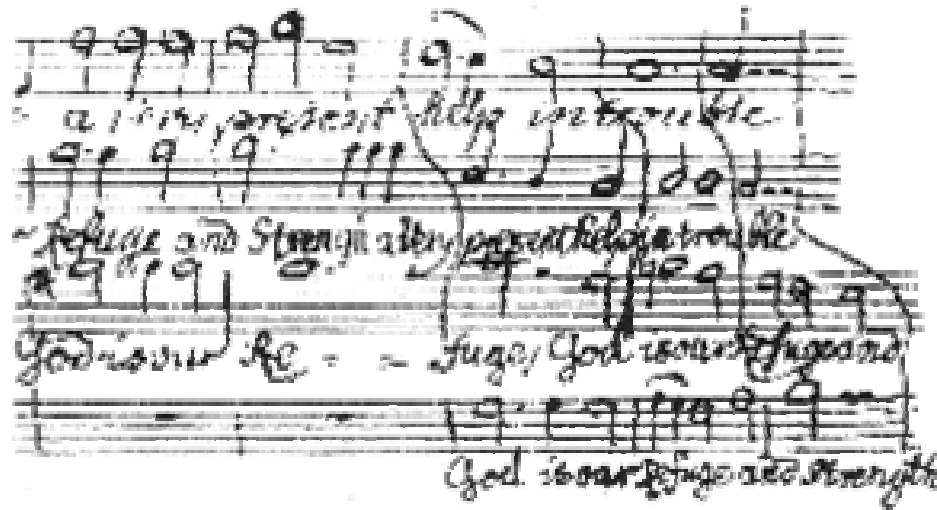


A Research Project in the 6th
Framework of the European
Community



Example for a Universal Language

by Mr. Wolfgang Mozart
1765.



Example for a Missing Dictionary



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



Methodology

- The workflows and requirements for the metadata model will be evaluated in interviews with users and manufactures.
- Workflow diagrams and metadata models will be documented as UML diagrams.

Image Quality Assessment

- Specification of assessment methods to evaluate the image quality of still and motion scenes in LSC for:
 - Acquisition
 - Postproduction
 - Presentation

Methodology

- Propose two methods to span expected IQ range:
 - **Forced Choice–Paired Comparison (FCPC)**
for small quality differences ($< 2\text{JND}$)
 - **Motion Ruler (MR)**
for large quality differences ($> 2\text{JND}$)
- The MR method is used today for still image quality assessment.
- We will develop a similar IQA method for motion scenes (Motion Ruler Method).

Motion Ruler Method



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



Procedure:

Ruler slid back and forth by observer to bring different ruler images adjacent to the test image

Business Models

- Specify business models, based on user requirements for Digital Cinema and 'rich media archive' applications.
- Evaluation of business cases
- Methodology
 - business models will be evaluated in interviews with users and manufactures.

Standardization

- Support the research and standardisation of layered scheme data compression and their integration into standards and systems for the media production environment, like MXF.
- Through work in application specific standardisation or specification bodies like:
 - SMPTE
 - DCI
 - JPEG
 - MPEG
 - EDCF

Other European Digital Cinema Projects

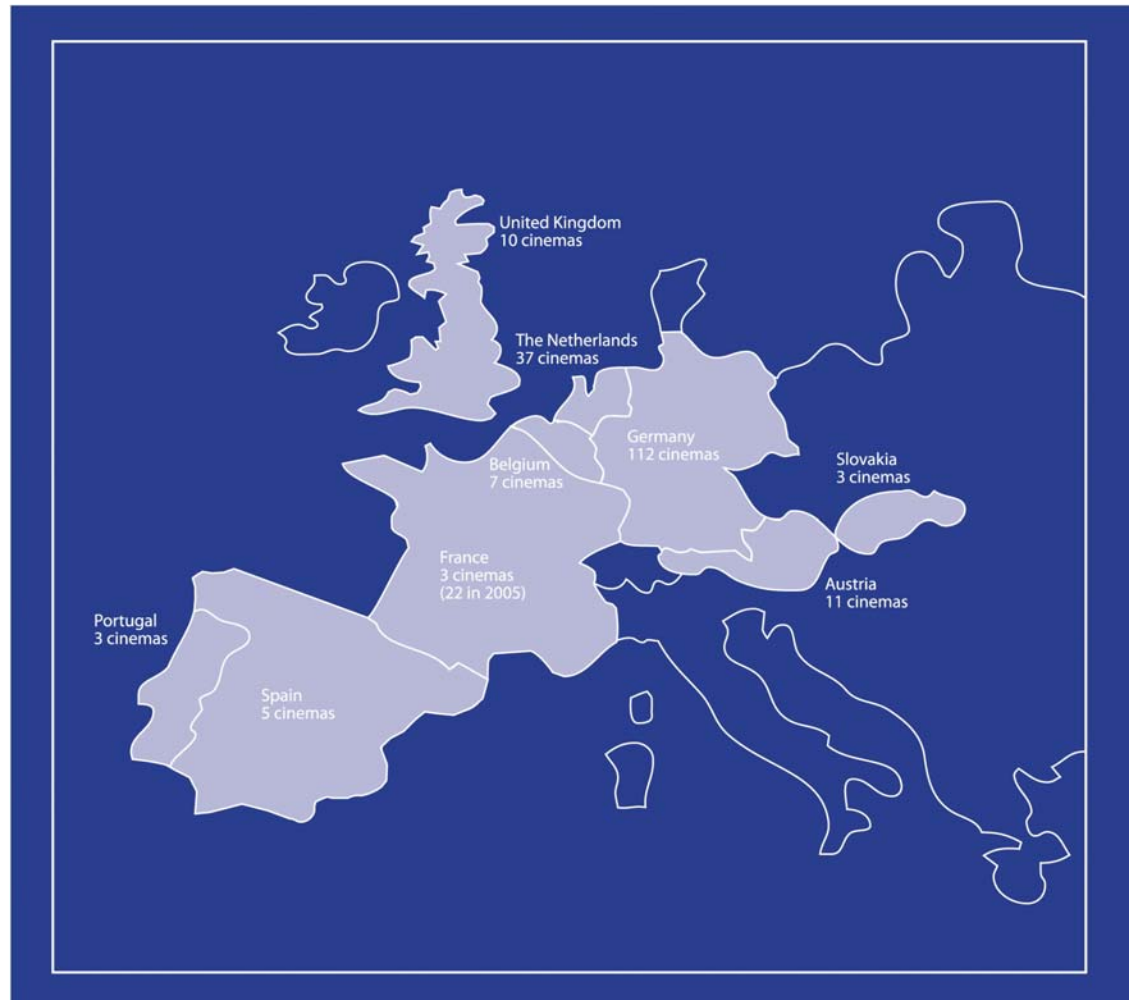


- **Launch: 12th November 2004**
 - Opening Weekend of the network with 8 documentaries
- **In 2005**
 - Each month a pan-European documentary release

CinemaNet Europe

- **Technical model**
 - Same IT infrastructure on MPEG2@HD level in 180+ theatres (GDC Technology server).
 - Combination of satellite and hard disk distribution.
 - DLP projector range designed for venues up to 200 seats.
 - Central play-out centres in Germany & The Netherlands.
- **Business Model**
 - *'Free' equipment in return for guaranteed performances for specialized films like documentaries.*

CinemaNet Europe



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



Other European Digital Cinema Projects

- RoWo
MPEG2 based systems (Own) for
Advertisement and Preshows, about 80
Screens in Germany & Austria (XGA up to
HDTV)
- T-Systems: Digital Cinema GLOBENET
platform
 - FACTORY Management Center
 - Satellite Services
 - FEATUREfilm Theatre Solution
 - 10 screens Europe-wide currently equipped
- XDC/FTT
-

**Thank you very much for your
attention!**

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

