Institut für Rundfunktechnik

EBU Seminar on Broadcast Networks and their security

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The use of MXF in file transfer

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Agenda

1. What is MXF?
2. Status of the specification
3. MXF technology
4. Use of MXF in an IT-based production environment
5. Related activities
6. Implementation and interoperability testing

1 The Material Exchange Format – What is it?

- A file format for the interchange and storage of essence and metadata
- A set of SMPTE documents (Standards, Recommended Practices, …)
- An **extensible** toolbox which supports
  - Many Essence types – DV, MPEG, PCM Audio, SDI, …
  - User Metadata (embedded and/or externally linked, may be dark)
  - Synchronisation of Essence Streams and/or Metadata
  - Material identification and tracking (SMPTE UMID)
  - Real-time replay, partial restore, versioning, in-place edit (cuts only), …
  - Interoperation with AAF applications
- A good candidate to address one aspect in the integration puzzle.

1.1 History of the Material Exchange Format

- 1998: Start of activities in EBU and Pro-MPEG Forum
- 1999: EBU P/PITV becomes platform for all manufactures
- 2000: Start of cooperation between AAF Association and Pro-MPEG
- 2001: Start of SMPTE Standardisation
- 2003: Release of first products (e-VTR, MXF::SDK)
- 2003: Finalisation of first SMPTE standards (Q4 2003)
- 2004: Availability of additional products, introduction in real-world facilities
- Next: Products, interoperability tests, production use, additional MXF specification documents and corrigenda

2 Status of the Specification

Finished documents

- **EG 41** – Engineering Guideline
- **SMPTE 377M** – Format Specification
- **SMPTE 378M** – Operational Pattern 1a (Single Item, Single Package)
- **SMPTE 391M** – Operational Pattern 1b (Single Item, Ganged Packages)
- **SMPTE 392M** – Operational Pattern 2a (Play-list Item, Single Package)
- **SMPTE 393M** – Operational Pattern 2b (Play-list Item, Ganged Packages)
- **SMPTE 390M** – OP "Atom" (Simplified Representation of a Single Item)
- **SMPTE 379M** – Generic Container
- **SMPTE 385M** – Mapping SDTI-CP into the MXF Generic Container

2 Status of the Specification

- Finished documents (continued)
  - **SMPTE 386M** – Mapping Type D-10 Essence Data to the MXF GC
  - **SMPTE 387M** – Mapping Type D-11 Essence Data to the MXF GC
  - **SMPTE 388M** – Mapping DV-DIF Essence Data to the MXF GC
  - **SMPTE 381M** – Mapping MPEG Streams into the Generic Container
- Registries (dynamic)
  - **RP 210** – SMPTE Metadata Dictionary
  - **RP 224** – Registry of SMPTE Universal Labels

2 Status of the Specification

- Documents in standardisation
  - **EG42** – MXF Descriptive Metadata
  - **SMPTE 382M** – Mapping AES3 and Broadcast Wave Audio into the GC
  - **SMPTE 388M** – Mapping A-law Coded Audio into the GC
  - **SMPTE 384M** – Mapping of Uncompressed Pictures into the GC
  - **SMPTE 389M** – Generic Container Reverse Play System Element
  - **SMPTE 394M** – System Item Scheme-1 for MXF Generic Container
  - **SMPTE 405M** – Elements and Individual Data Items for the GC SI Scheme 1
  - **SMPTE 380M** – Descriptive Metadata Scheme - 1 (DMS-1)

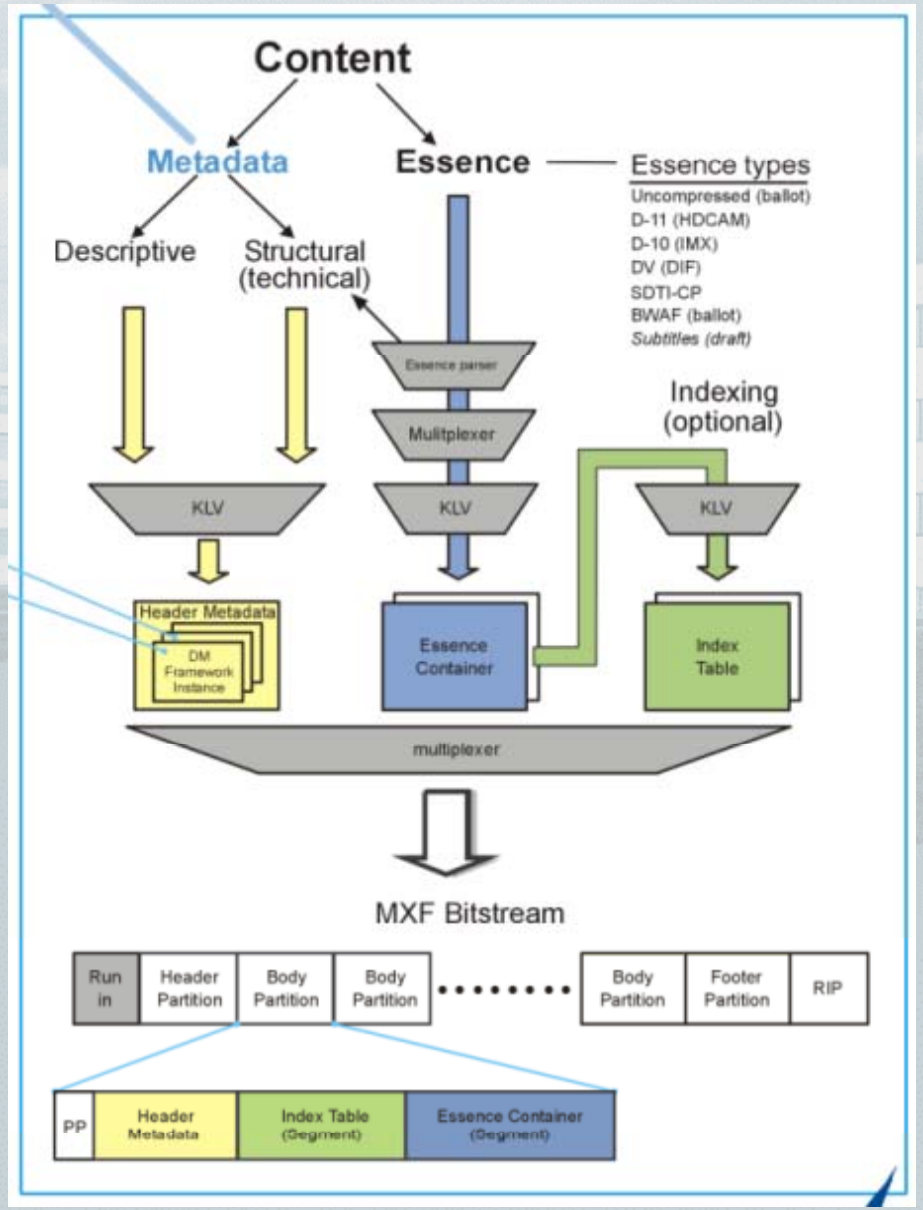
2 Status of the Specification

- Working documents and projects
  - Carriage of Data Streams in MXF
  - SMPTE Types and Sets Registries
  - XML Schema representations for MXF and DMS-1
  - Revision of RP 205 – Application of the UMID in Production and Broadcast
  - Carriage of Subtitling information
  - Security and Encryption (KLV layer)

3 MXF technology – Overview

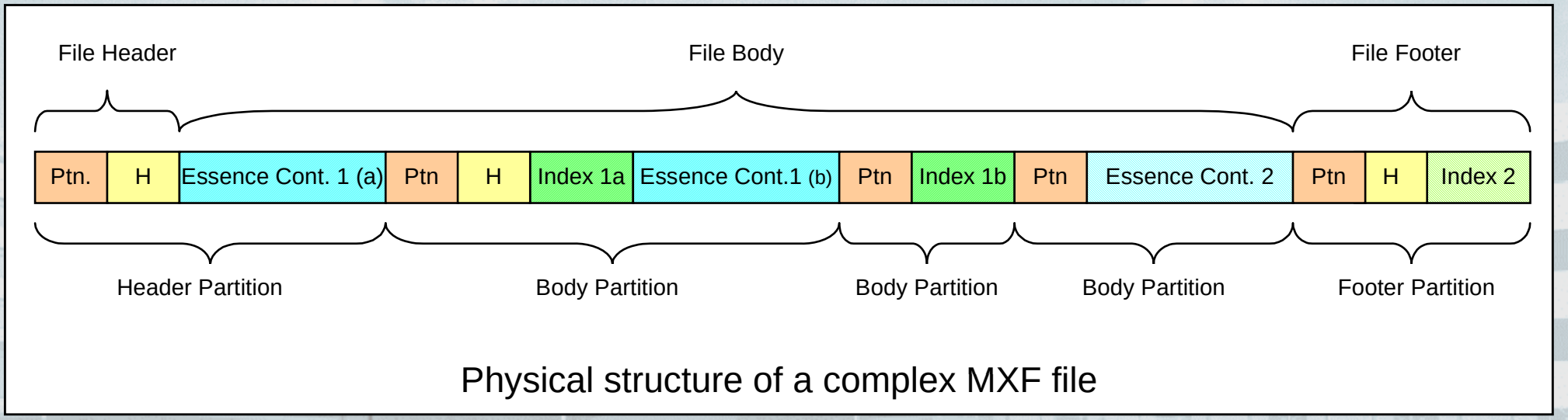
- **Header Metadata**
  - Structural: defines technical parameters, its logical structure and timeline
  - Desciptive: user Metadata (titles, scene descriptions, rights information, …)
- **Essence Container** (optional)
  - Contains the audio, video and data Essence stored in the file
  - Offers a multiplex mechanism for these Essence types (streaming)
- **Index Tables** (optional for each Essence Container)
  - Enable fast frame access (byte offset to frame)
  - Support fractional timing of Essence (e.g. video and MPEG audio frames)
- **Partitions** (multiplex and signalling mechanism)
  - Header Metadata, Essence Containers and Index Tables into byte stream
  - Navigation mechanisms to segments of Essence Containers and Index Table

3 MXF technology – Overview



Simplified workflow of a MXF Generator

3 MXF technology – Overview



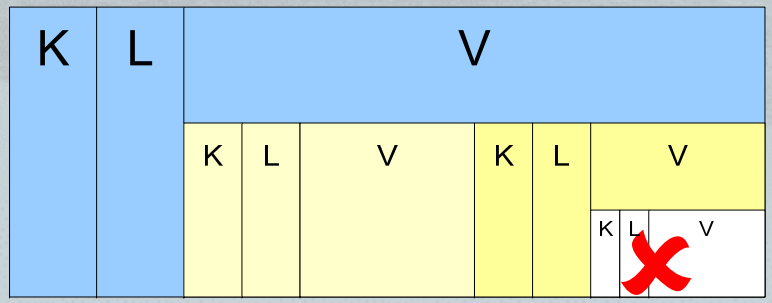
Physical structure of a complex MXF file

Low-level binary coding protocol

KLV (Key-Length-Value)

SMPTE Standard, guarantees extendibility

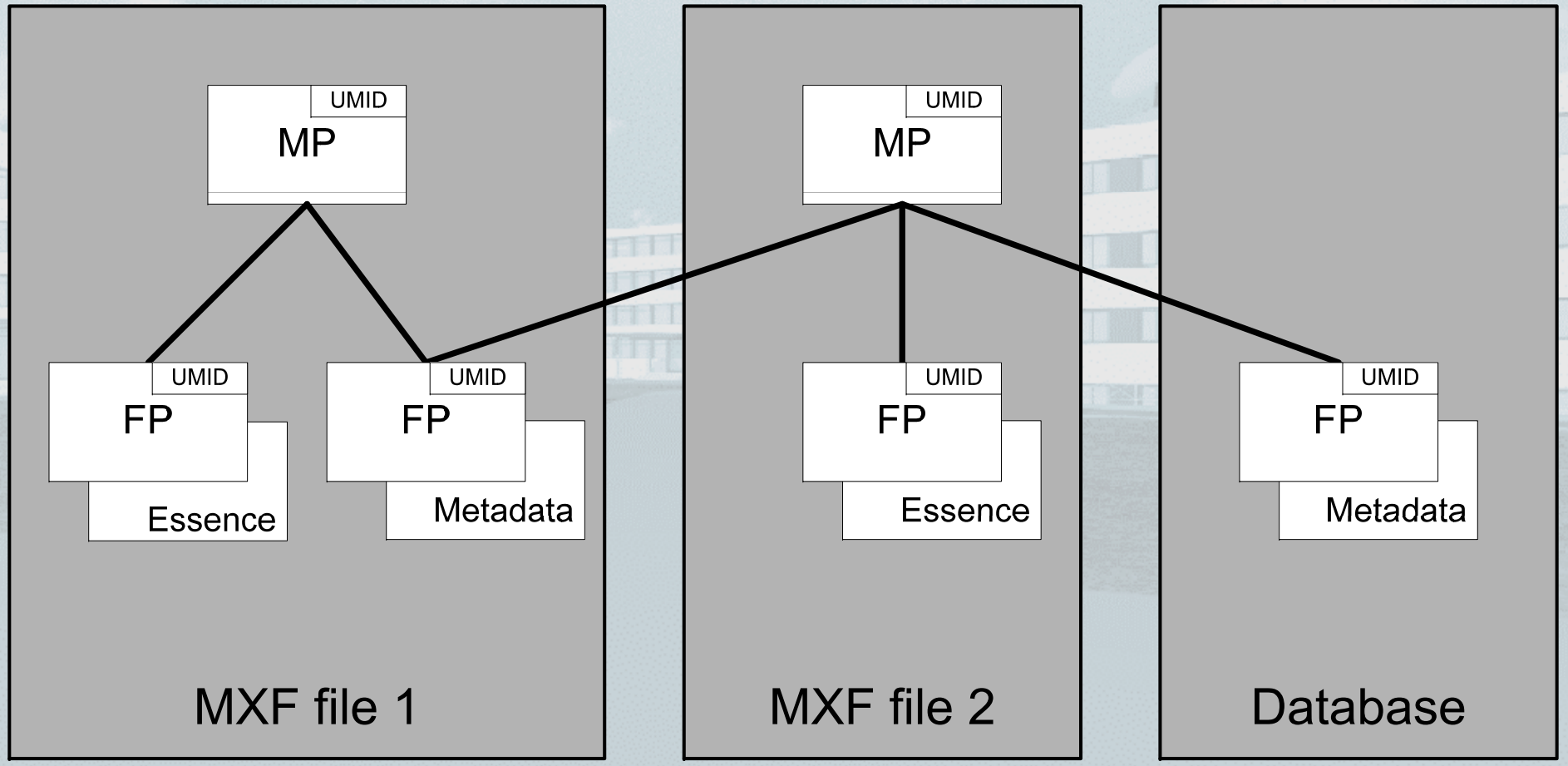
2-level constraint to reduce processing overhead



3 MXF technology – Packages have...

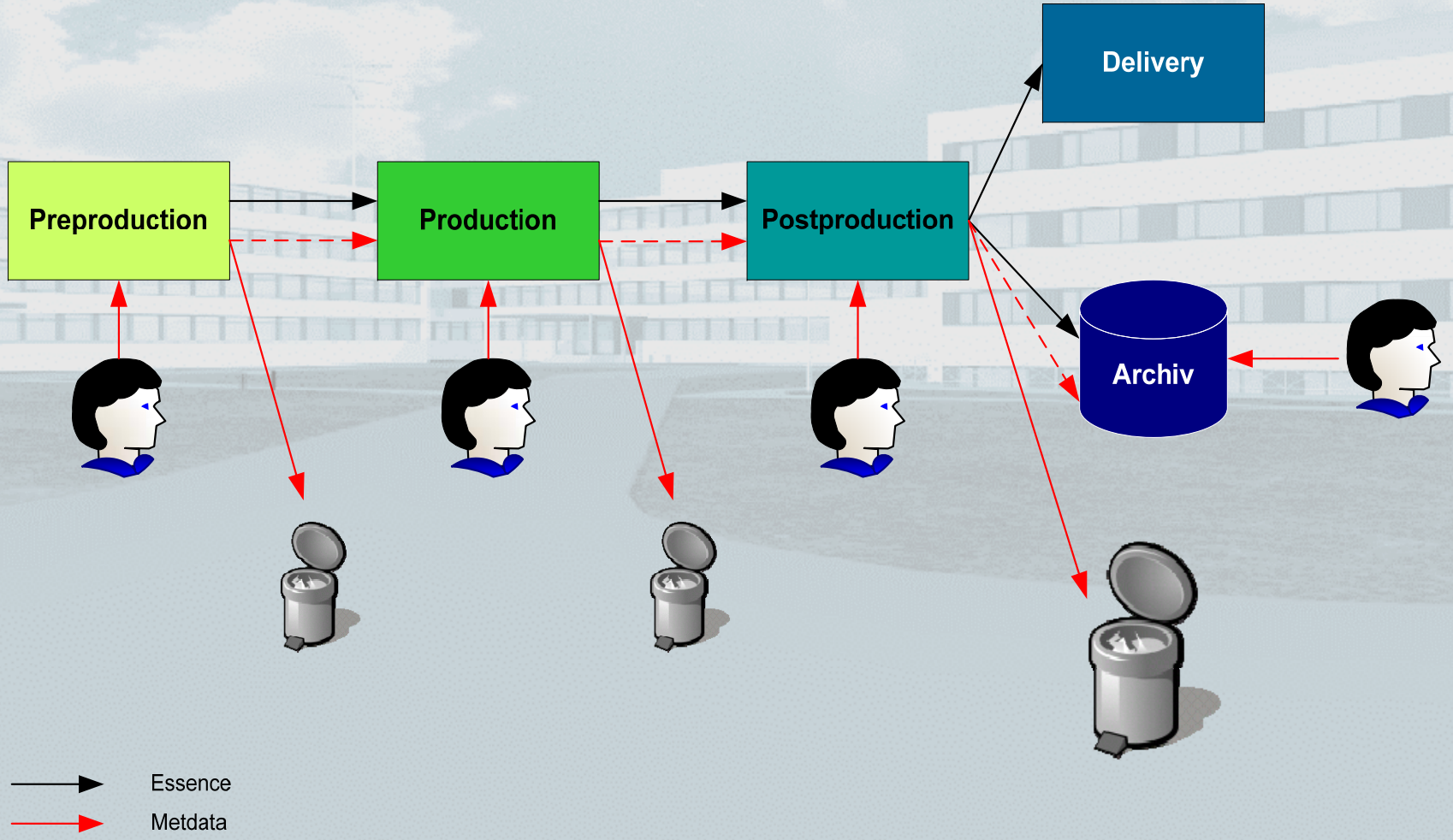
- **A Unique ID** – SMPTE Unique Material Identifier (**UMID**)
  - Globally unique. Material tracking, Metadata linking.
- **Essence Descriptor(s)**
  - Technical metadata about the material (coding, frame rate, image size, …)
- **Tracks**
  - Synchronisation mechanism for Essence streams and associated Metadata
  - Tracks can be timecode tracks or (continuous) timeline, event or static tracks
  - Can link elements in Essence Containers (e.g. pictures or audio segments)
  - Can link to external Essence (e.g. DV/DIF file)
  - Can contain Descriptive Metadata and link it to other tracks in the Package
  - Can link to other tracks in other packages (maybe external to the file).

3 MXF technology – Package linking



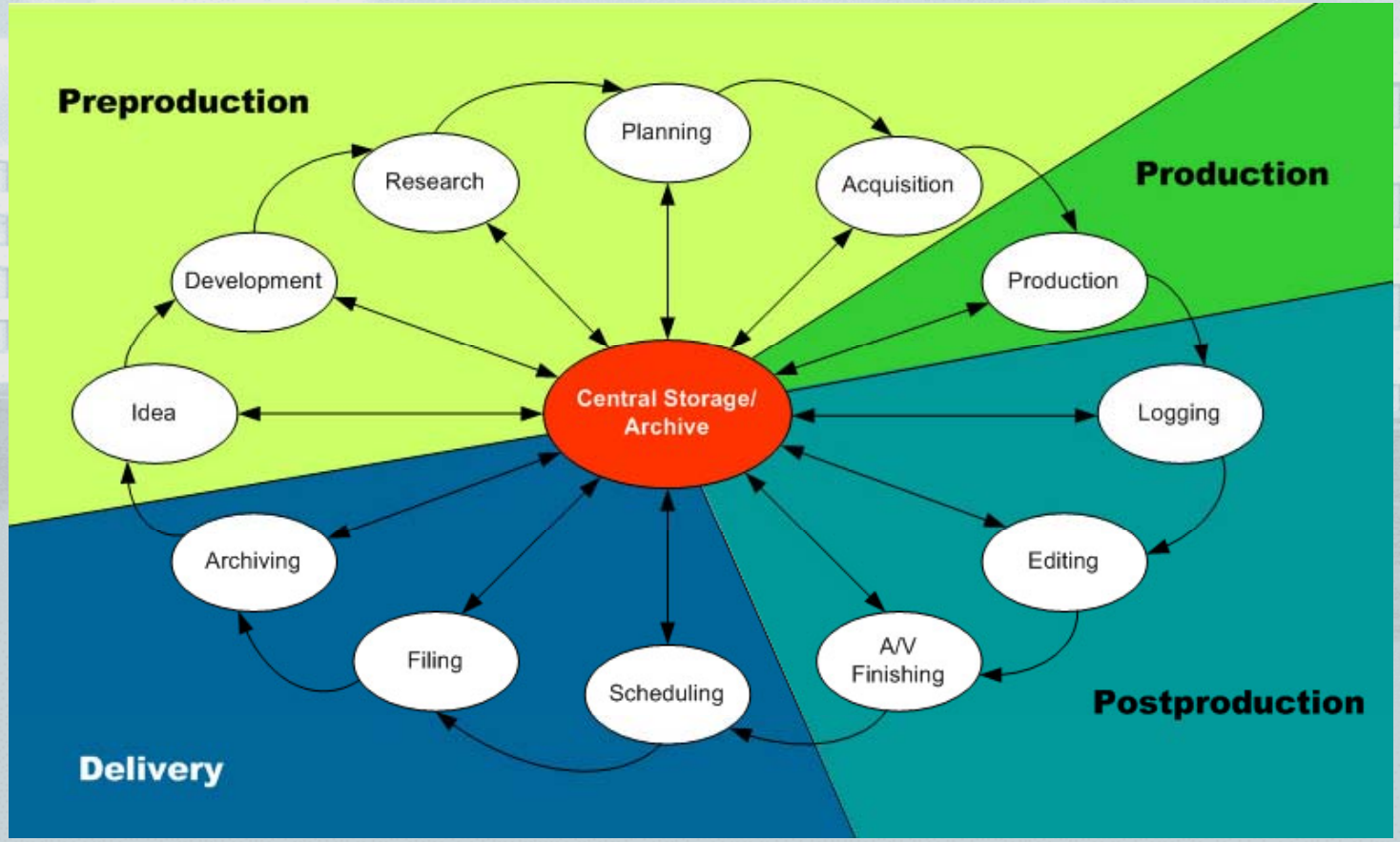
4 Use of MXF in an IT-based production environment

a) Linear workflow of Essence and Metadata (present)



4 Use of MXF in an IT-based production environment

b) Integrated workflow of Essence and Metadata (present/future)



Content (Essence and Metadata)

4 Use of MXF in an IT-based production environment

Features of an IT-based production:

- archive will be the central library of the production
- metadata will be stored and used through whole cycle
- faster creation, editing and interchange of content
- distributed production
- scalable formats for production (browsing, broadcast, ...)
- scalable formats for delivery (TV, DVD, internet, ...)
- major components: file formats, networks, storage

4 Use of MXF in an IT-based production environment

Features of MXF:

- independent of compression systems, formats, and platforms
- essence and metadata synchronisation
- different essence types wrapped in one file
- internal or external essence
- identification of the content and metadata (UMID)
- support of file based exchange and streaming
- interoperable with AAF
- standardised by SMPTE

5 Related Activities

- SMPTE Engineering Committees
  - Standardisation
- Pro-MPEG Forum – File Interchange Group (www.pro-mpeg.org)
  - Proponent of some current specification documents (data streams, security)
- Pro-MPEG Forum – File Implementers Group (www.mxf.info)
  - Input for SMPTE corrigenda process
- Joint Pro-MPEG / AAF Association Committee
  - Maintenance of AAF/MXF Interoperability – Zero Divergence Doctrine (ZDD)

5 Related Activities

- **EBU P/TV-File**
  - PMC working group
  - Carriage of User Metadata, in particular P_META and DMS-1
  - Help EBU members to understand MXF technology
  - Identify needs / define requirements for MXF testing wrt. operational use
  - Platform for discussion between users and suppliers of MXF equipment
  - Provide guidelines / profiles to deal with specific application environments
  - Address questions to P/TV-File secretary

    Hans Hoffmann <hoffmann@ebu.ch>
  - MXF overview poster

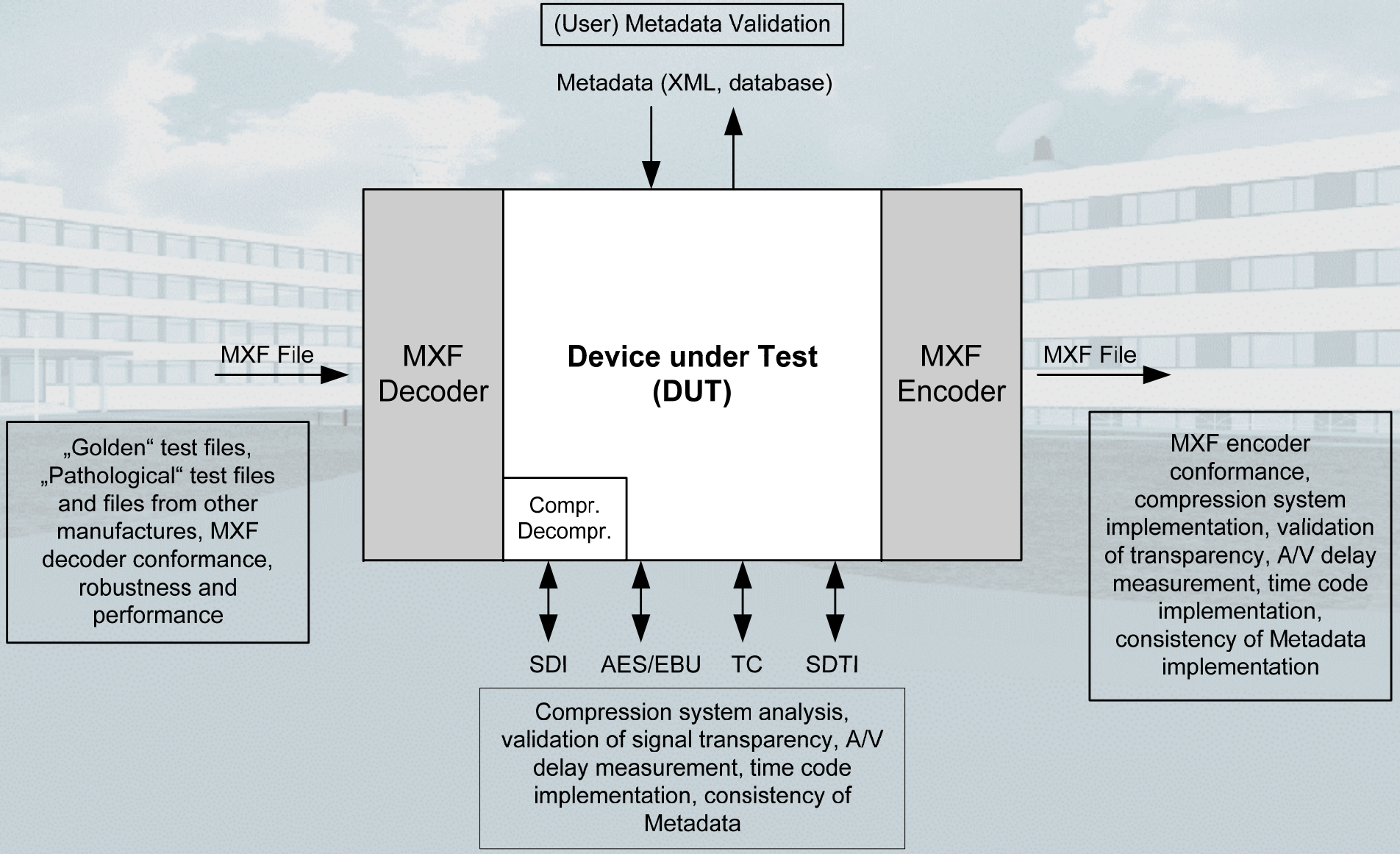
    http://www.irt.de/mxf/information/mxf-poster.pdf

6 Implementation and Testing

- A large number of manufactures have announced commitment
- MXF is a toolbox, the specification represents IT/TV convergence
- Implementation in products is not trivial
- Different approaches exist, e.g. wrt. dark metadata
  - Vendor and/or application specific data unknown to the receiver
  - Tunnelling or filtering
  - Not a problem, but MXF decoder need to be well-implemented
- Testing is essential to establish interoperability (as early as possible)
- IRT has set up MXF Test Center

  http://www.irt.de/mxf/

6.1 Testing of MXF Products



6.2 Contacts of the MXF Test Centre

- Manufactures (selected)

– Anystream	– Avid	– D.A.V.I.D.	– Dalet	– Doremi
– EVS	– FPDI	– IBIS	– IBM	– Ligos
– Matrox	– Omneon	– Optibase	– Panasonic	– Pinnacle
– SGI	– Sony	– Snell&Wilcox	– T-Systems	– Thomson GVG

- Users (selected)

– BBC	– BR	– CBC
– CNN	– Euskatel	– Hong Kong Cable TV
– KBS (Korea)	– NOB	– WDR

- First report: Sony e-VTR (planned for 06/2004)

Thank you for your attention.

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