ISOBMFF@DVB
"Beyond TS" Workshop

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Overview

- ISOBMFF, standards and statuses
- ISOBMFF basic concepts
- Types and usages of ISOBMFF files
- On-going works
- How to extend the ISOBMFF ?

ISOMBFF: standards and statuses (1/2)

- **ISO Base Media File Format, formally known as:**
  - 14496-12 (MPEG) and 15444-12 (JPEG)
  - identical text, for historical reasons

- **Core specification for several formats, freely available**
  - 4th edition published in 2012: 14496-12:2012
  - 5th edition about to be published integrating
    - AMD1:2013 (files with brand iso7)
    - COR1:2013 (item location)
    - AMD2:2014 (timed text)
    - COR2:2014 (timed text, sidx)
    - AMD3:2015 (fonts, files with brand iso8)
    - COR3:2015 (fragments)
    - AMD4 (iso9, audio, language, SAP)

ISOMBFF: standards and statuses (2/2)

- **MPEG-defined extension specifications**
  - **Carriage of MPEG-4 Systems data in ISOBMFF**
    - 14496-14:2003 (strictly speaking the MP4 FF, iods box)
  - **Carriage of NAL-unit structured video in ISOBMFF (AVC, HEVC, …)**
    - 14496-15:2014 & 14496-15:2014/Cor1:2015
  - **Carriage of MPEG-21 assets**
    - 21000-9:2005
  - **Carriage of TTML and WebVTT in ISOBMFF**
    - 14496-30:2014
- **Other extensions**: 3GPP, F4V, …

ISOBMFF: conformance and reference software

- Conformance bit streams
  - ISO/IEC 14496-4
  - Some streams are freely available
    - See http://standards.iso.org/ittf/PubliclyAvailableStandards/
  - More are welcome

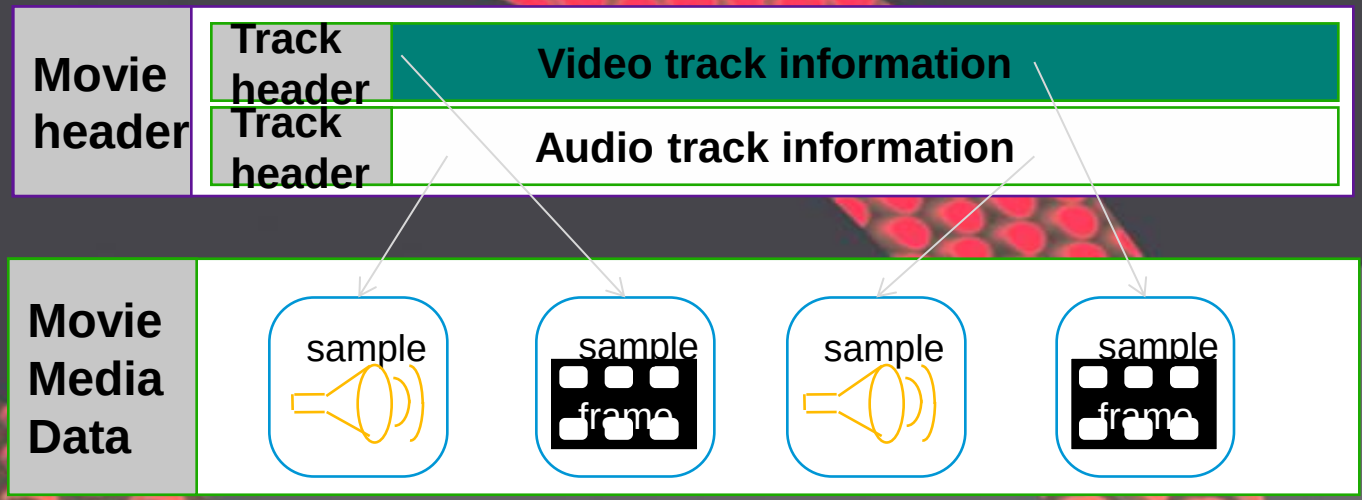
- Software
  - ISO/IEC 14496-5
  - Reference software, freely available
    - C, ISO Licence
    - Read/Write MP4 files
  - Contributions are welcome

- Intent to remove technologies from standard (corrigendum)
  - If no bitstream
  - And no reference software

ISOBMFF: Logical Structure

- A file
  - Contains
    - Timed data in tracks of a movie
    - Other data (untimed) in items
    - Or a combination of both
  - Defines a common timeline for all tracks to be synchronized
- A track
  - Corresponds to a specific media type (codec),
  - Is associated to a single decoder (except for scalable codecs),
  - May be linked, grouped or alternative to other tracks
  - May have associated untimed data in items
  - May be encrypted
  - Is decomposed into samples
- A sample
  - Represents contiguous data used by a decoder at given times (DTS, CTS)
  - Has properties (size, position, random access, decoder configuration…)
  - May be described in terms of sub-samples
  - May be associated to other similar samples in sample groups
  - May have sample-specific auxiliary information
- An item
  - Represents data consumed as a whole and valid for the entire duration of the movie,
  - Has properties (type, position, size …)
  - May be encrypted, compressed, …

ISOBMFF: Separation of data



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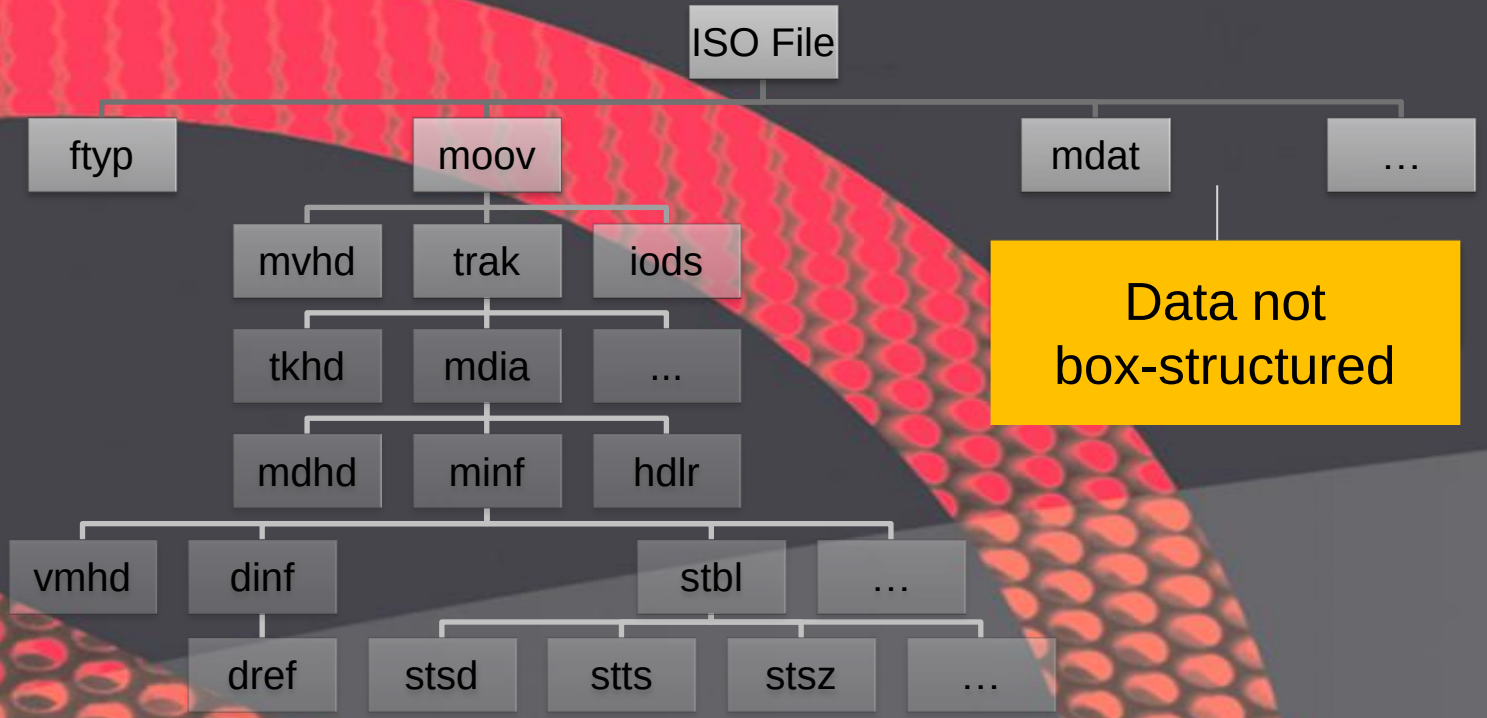
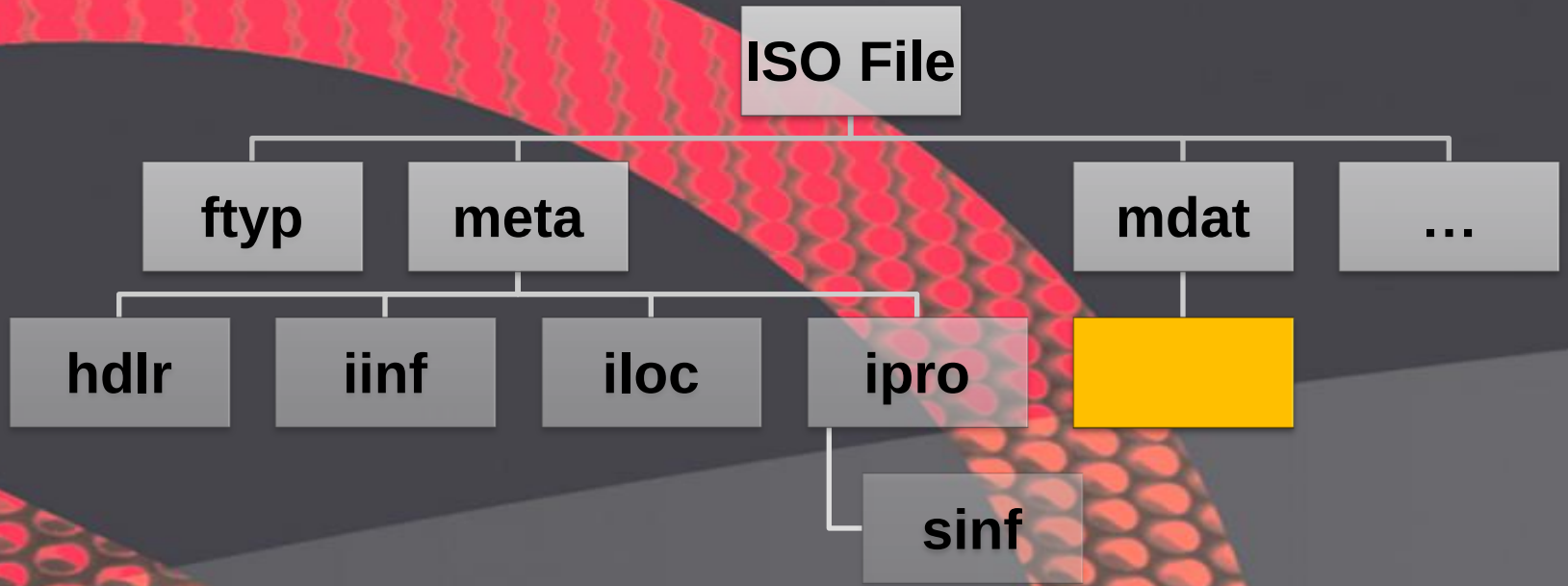
ISOBMFF: Physical Structure

- Data is stored in a basic structure called box
  - No data outside of a box
- Each box has length, type (4 printable chars), possibly version and flags, and data
  - Extensible format:
    - Unknown boxes can be skipped (syntactically)
- Header information is a hierarchical set of boxes (typically ‘moov’ or ‘meta’)
- Media data is stored unstructured, in boxes (mainly ‘mdat’, or ‘idat’) in the same file as the header or may be stored in a separate file

Typical Box Hierarchy (1 track)



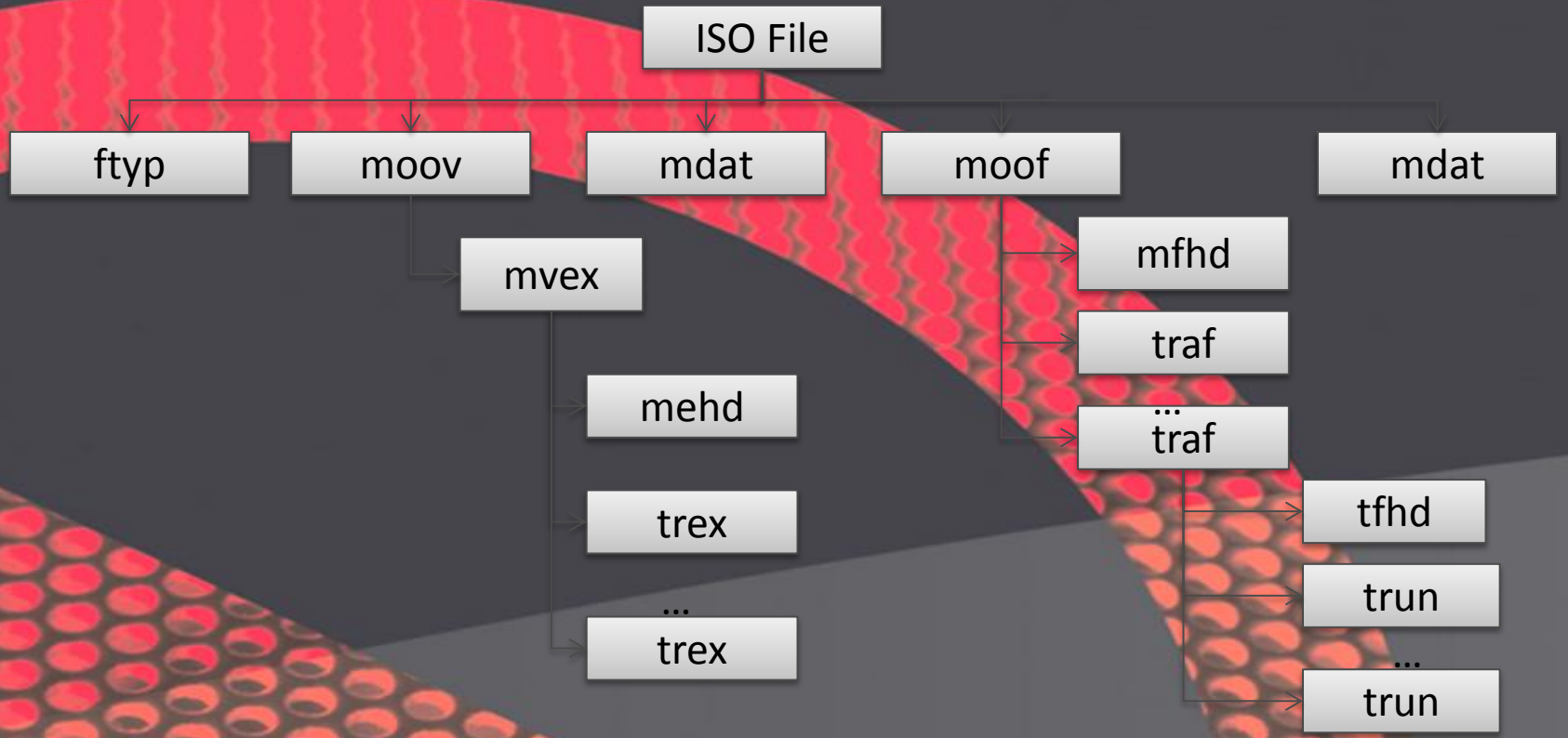
Typical Box Hierarchy (Untimed)



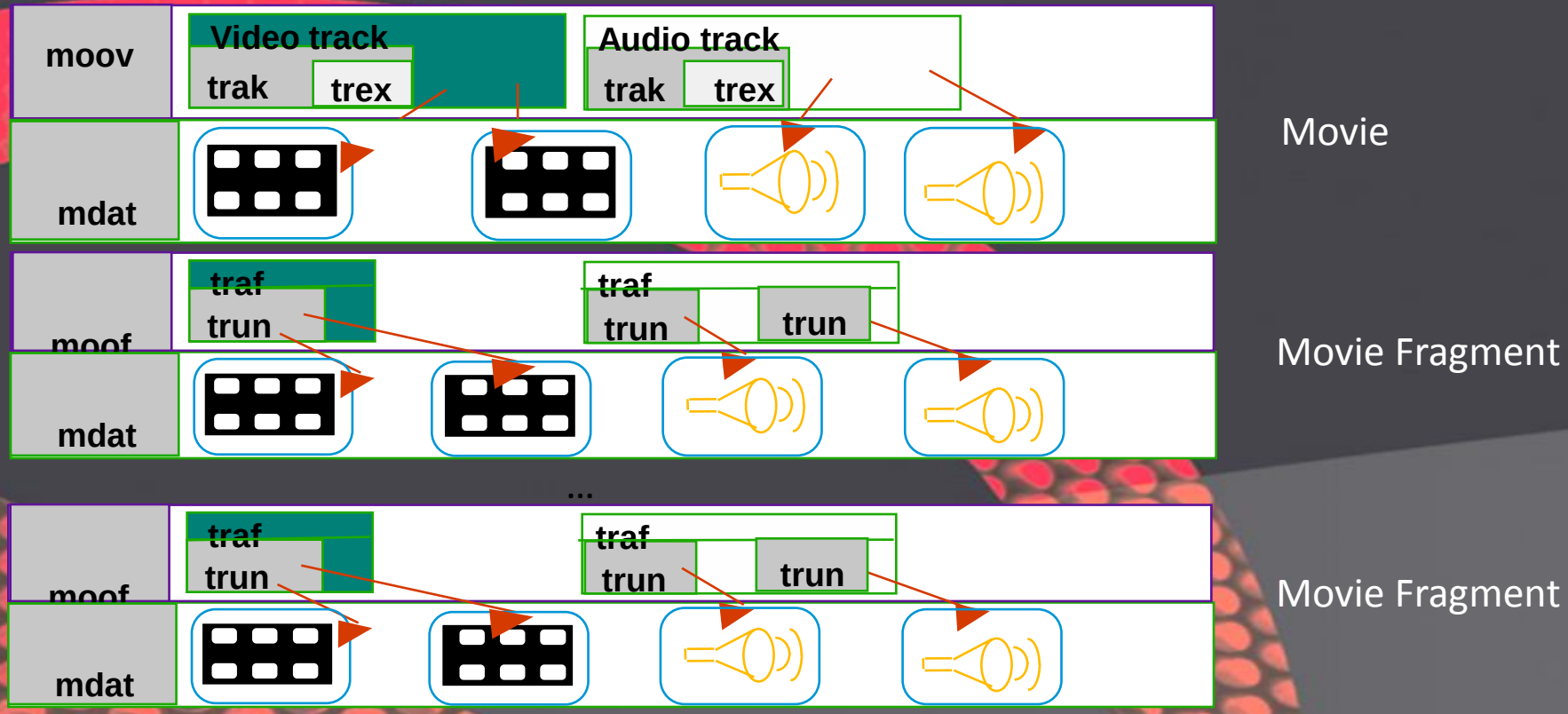
ISOBMFF: File Types & Usages (1/2)

- **Plain Files**
  - Simple recording of timed data (data first, header last)
  - ISOBMFF Tools: mdat, moov, …
- **Progressive Files**
  - Progressive download and playback (Header first, data last and interleaved)
  - ISOBMFF Tools: storage using chunk offsets
- **Fragmented Files**
  - Files for long-running recording sessions (multiple blocks of header and data)
  - ISOBMFF Tools: Movie fragments

Movie Fragments Hierarchy



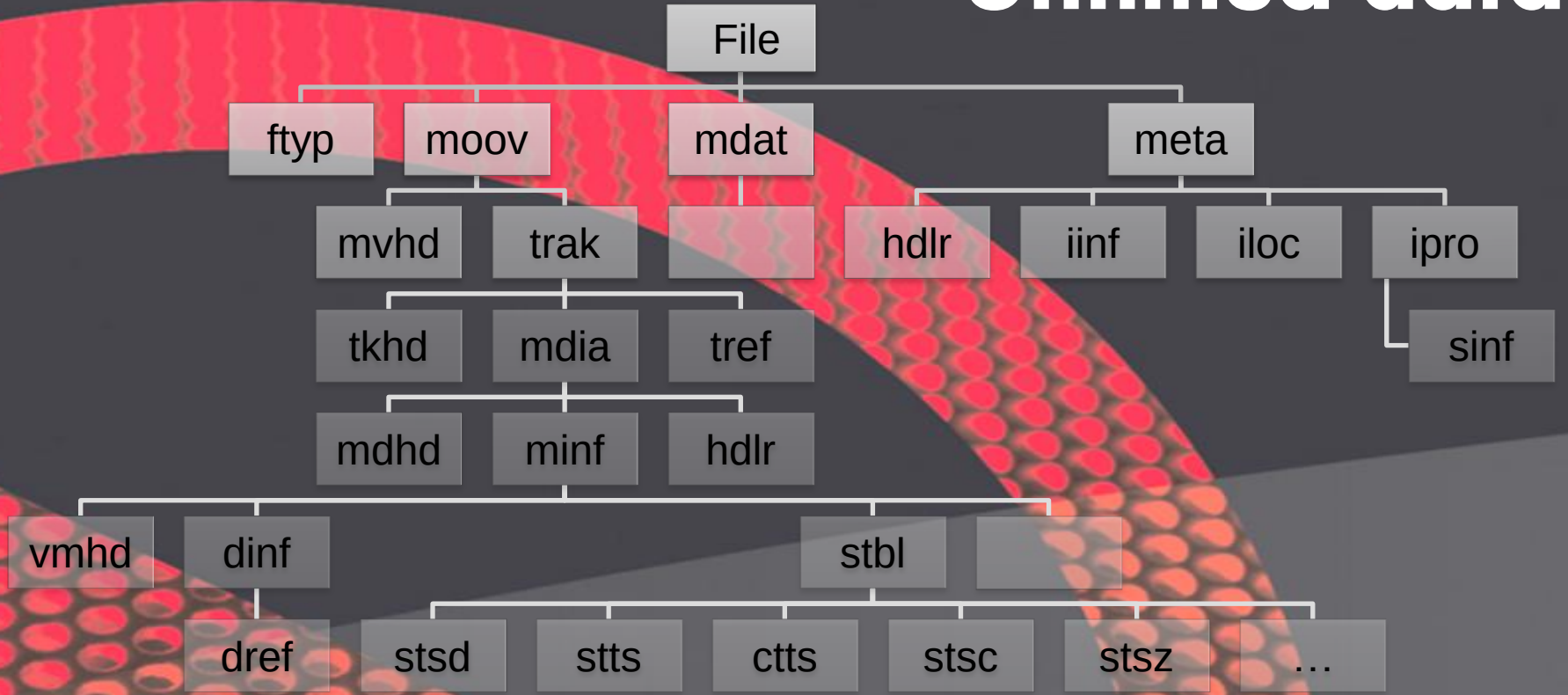
Structure of a fragmented file



ISOBMFF: File Types & Usages (2/2)

- **Segmented Files**
  - Self-contained fragments stored in separate files for HTTP streaming
  - ISOBMFF Tools: Initialization vs. Media Segments, indexing
- **Streamable files**
  - Protocol-specific instructions to create streams from files
  - ISOBMFF Tools: hint tracks (RTP, FLUTE, …)
- **Stream recording files**
  - Recording of protocol-specific packets into files for replay
  - ISOBMFF Tools: reception hint tracks (RTP, MPEG-2 TS)
- **Packaging files**
  - Storage of related timed or untimed data (e.g. JPEG or XML + audio/video)
  - ISOBMFF Tools: 'meta'

Dual Headed File: Timed and Untimed data



Identifying ISOBMFF files

- **Extension not sufficient**
  - mp4, m4a, m4s, 3gp …
- **Magic number: ‘ftyp’/‘styp’**
  - brands
    - Compatible brand: “claim and permission”
    - Major brand: “best use”
  - “isom”, “avc1”, “isoX” (X=2…9), “mp41”, “mp71”, …
- **MIME types and codecs (RFC 6381)**
  - “video/mp4”: if it contains visual data
  - “audio/mp4”: otherwise, if it contains audio,
  - “application/mp4”: otherwise (in particular metadata, …)
  - “codecs” sub-parameter
    - Comma-separated list of track information
    - Uses the sample entry 4cc: “avc1”, “mp4a”, “stpp”,
    - Additional codec-specific information (profiles, levels …)
  - “profiles” sub-parameter

On-going developments

- **Layered HEVC**
  - **Scalable, multiview, …**
- **Sample Variants**
  - **Multiple versions of each sample**
  - **Instructions to reconstruct a unique stream**
- **Image File Format**
  - **Storage of HEVC still images or image collections (short animations, multispectral, …)**

Extending the ISOBMFF (1/3)

- **Easy extensions**
  - New codec for temporal data for which you own the sample format (e.g. Opus in MP4)
  - New sample groups for (codec-specific) annotation of samples (e.g. HEVC CRA/BLA)
  - New sample auxiliary data , for (codec-specific) per-sample data (e.g. init vector, …)
  - New untimed data format (e.g. EXIF, XMPP …)
  - New user-, vendor-specific data (use 'meta', 'udta', 'free', 'skip', or 'uuid' boxes)

Extending the ISOBMFF (2/3)

- **Harder extensions**
  - **Beware of backwards compatibility !**
  - **Only if all other options have been exhausted**

  - **Extending existing boxes**
    - **Use versioning and/or flags**

  - **New boxes (almost always the wrong option!)**
    - **Check for name clashes (www.mp4ra.org)**
    - **Define box syntax and semantics**
    - **Choose box location and cardinality**
      - **Timed/Untimed information**
      - **File level, segment level, movie level, track level, sample level, …**
    - **Define new brand if it implies behavior changes/incompatibilities**

Extending the ISOBMFF (3/3)

- **Process recommendations**
  - **Inform/discuss on mp4-sys mailing list, by liaisons or by attending the meetings,**
  - **Register non-MPEG code points with registration authority**

Summary

- **Successful file format**
  - **Very versatile: from editing to HTTP streaming**
  - **Very extensible (codecs, usages, …)**
  - **Some problems ("Beyond MP4" experiment)**

- **"The" Solution beyond TS ?**
  - **Check broadcast-specific requirements (tune-in, compression, …) -> adopt the format or extend the format**

Thank you

QUESTIONS ?