Multimedia content

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* Part of the material comes from other sources.

Introduction

- Which kind of content do you consume?
- Platform / Device?
- Network Technology?
- How is it transmitted?

Introduction

- Which kind of content do you consume?
  - Audio (radio, music), video (TV programs, movies, video clips, series), …
- Platform / Device?
  - Analogic / Digital Radio, TV, cinema, smartphone, computer, tablet, …
- Network Technology?
  - ADSL, Optical Fiber, Mobile, WiFi, …

- How is it transmitted?
  - DTT, Analogic radio, On-demand, Broadcasted through Internet, …

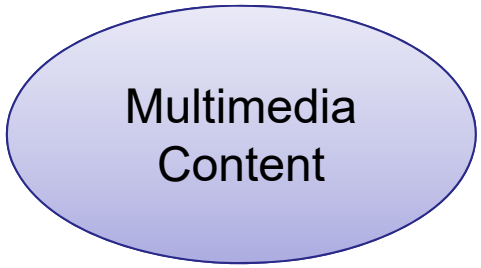
Introduction

- Content currently consumed groups different kinds of content
- Content can be combined in many different ways
- Several types of content (media) combined

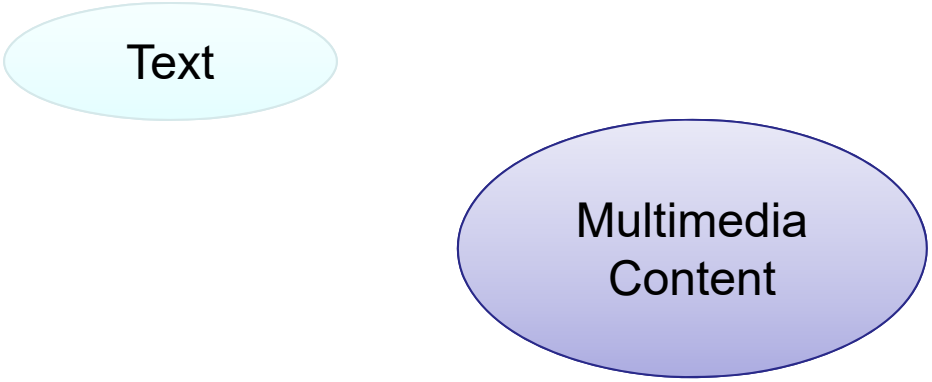
  ➡ **Multimedia Content**

- So, this topic is about
  - which kind of content can we have
  - how can we combine them
  - how are they organized for their consumption

Multimedia Content, what is it?



Multimedia Content, what is it?



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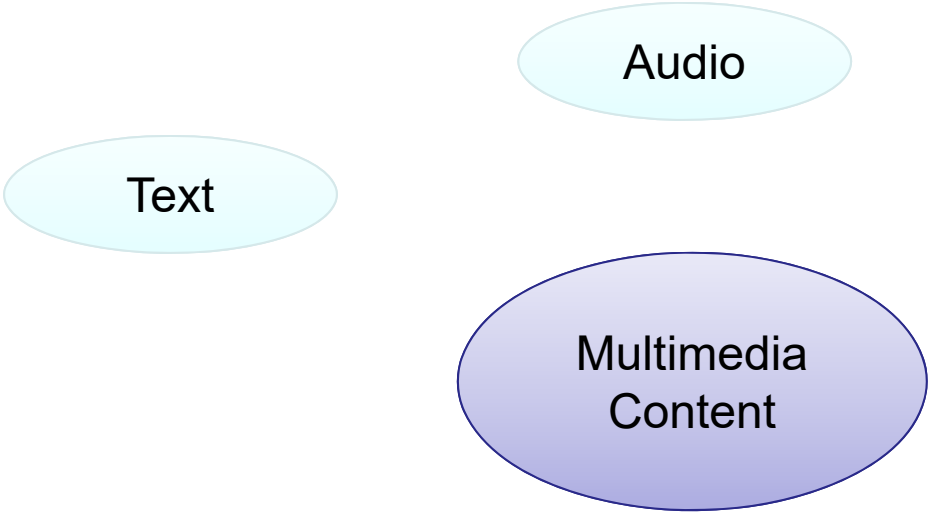
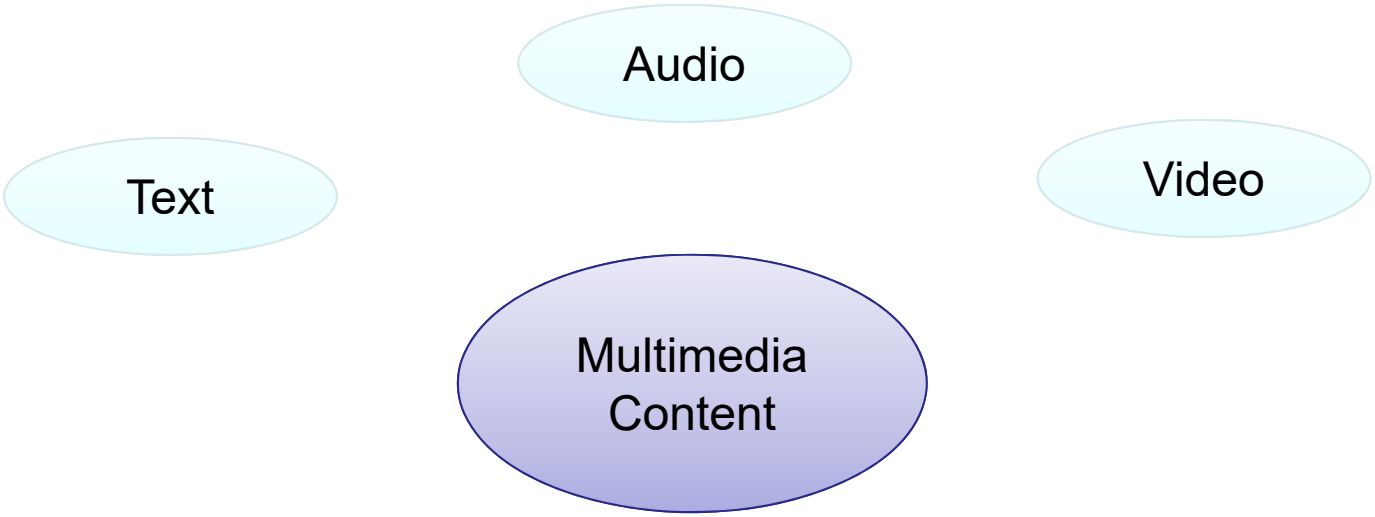
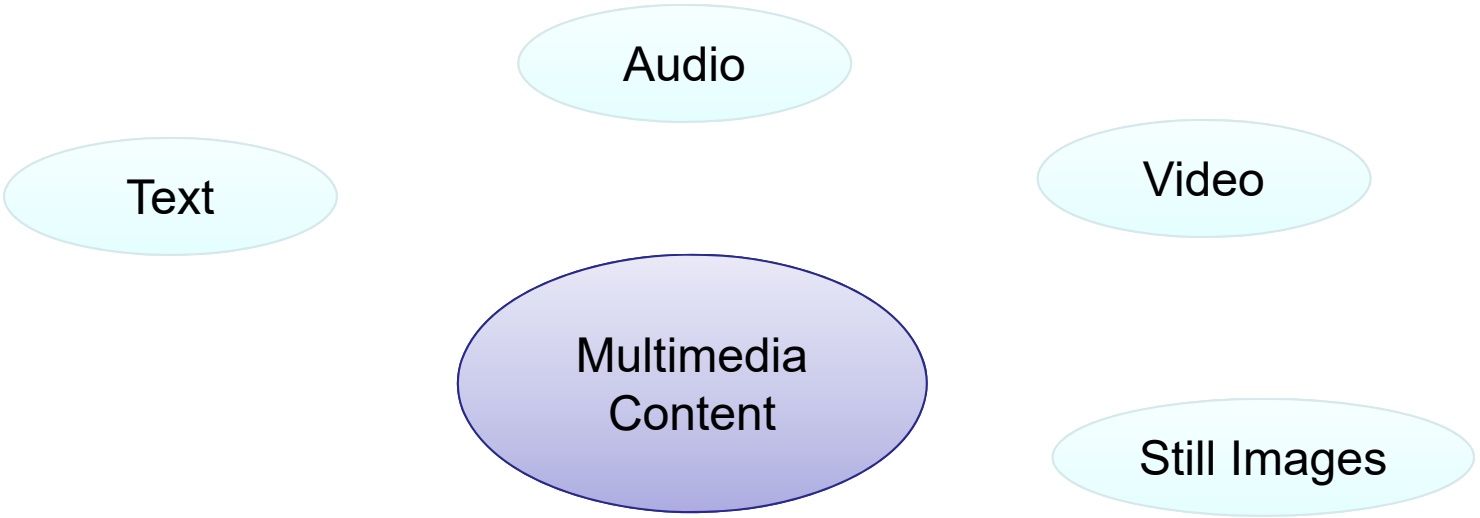


Multimedia Content, what is it?



Multimedia Content, what is it?



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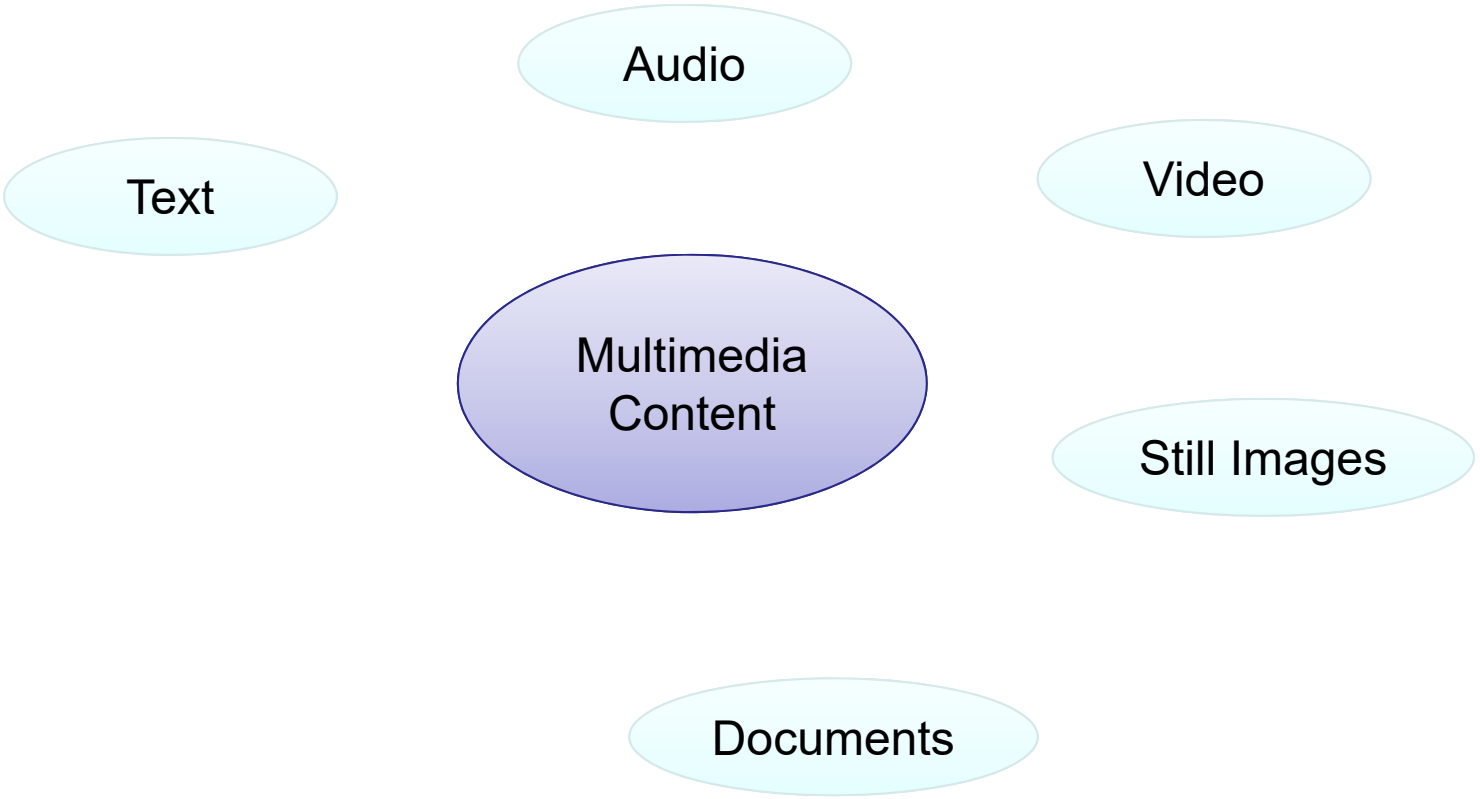

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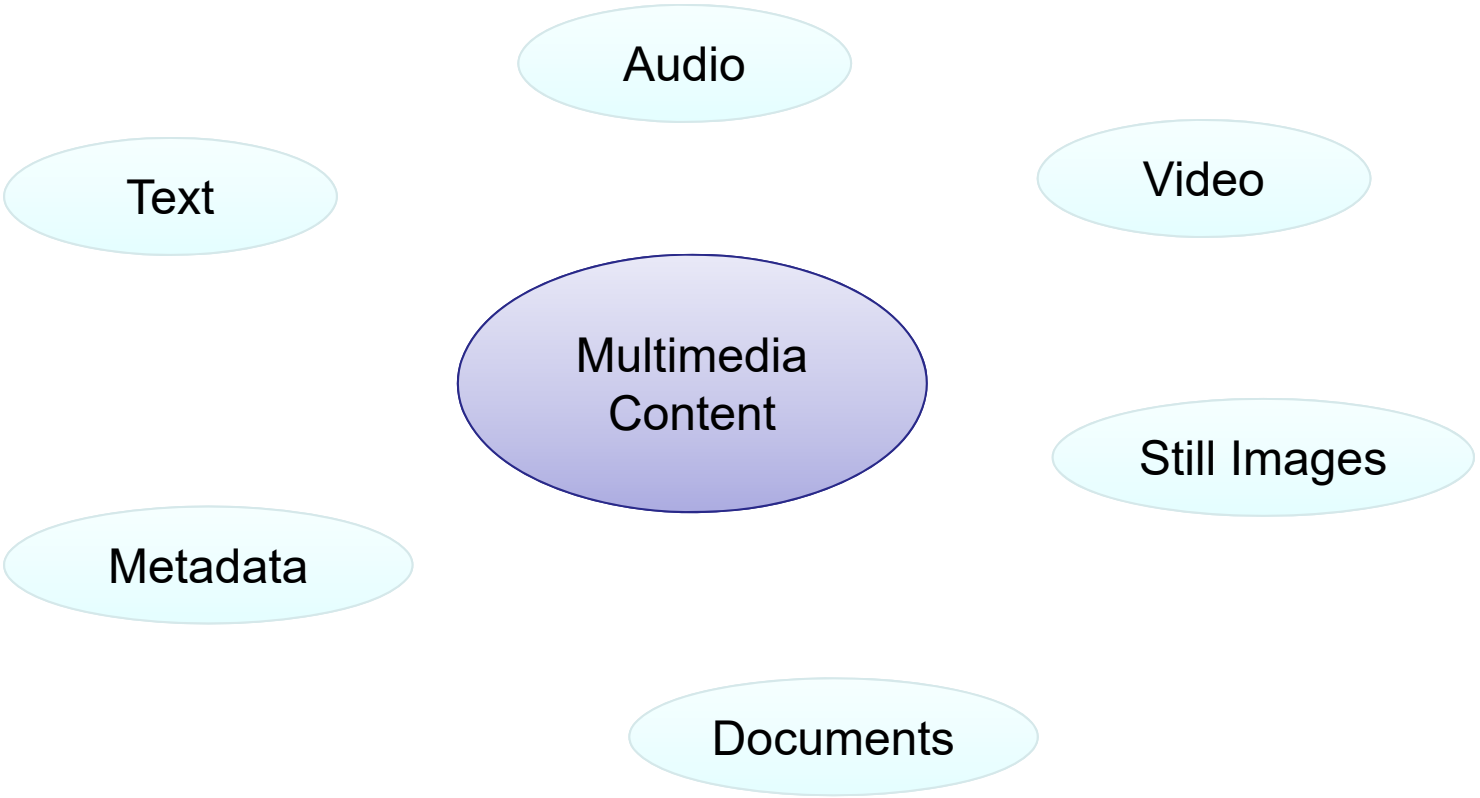
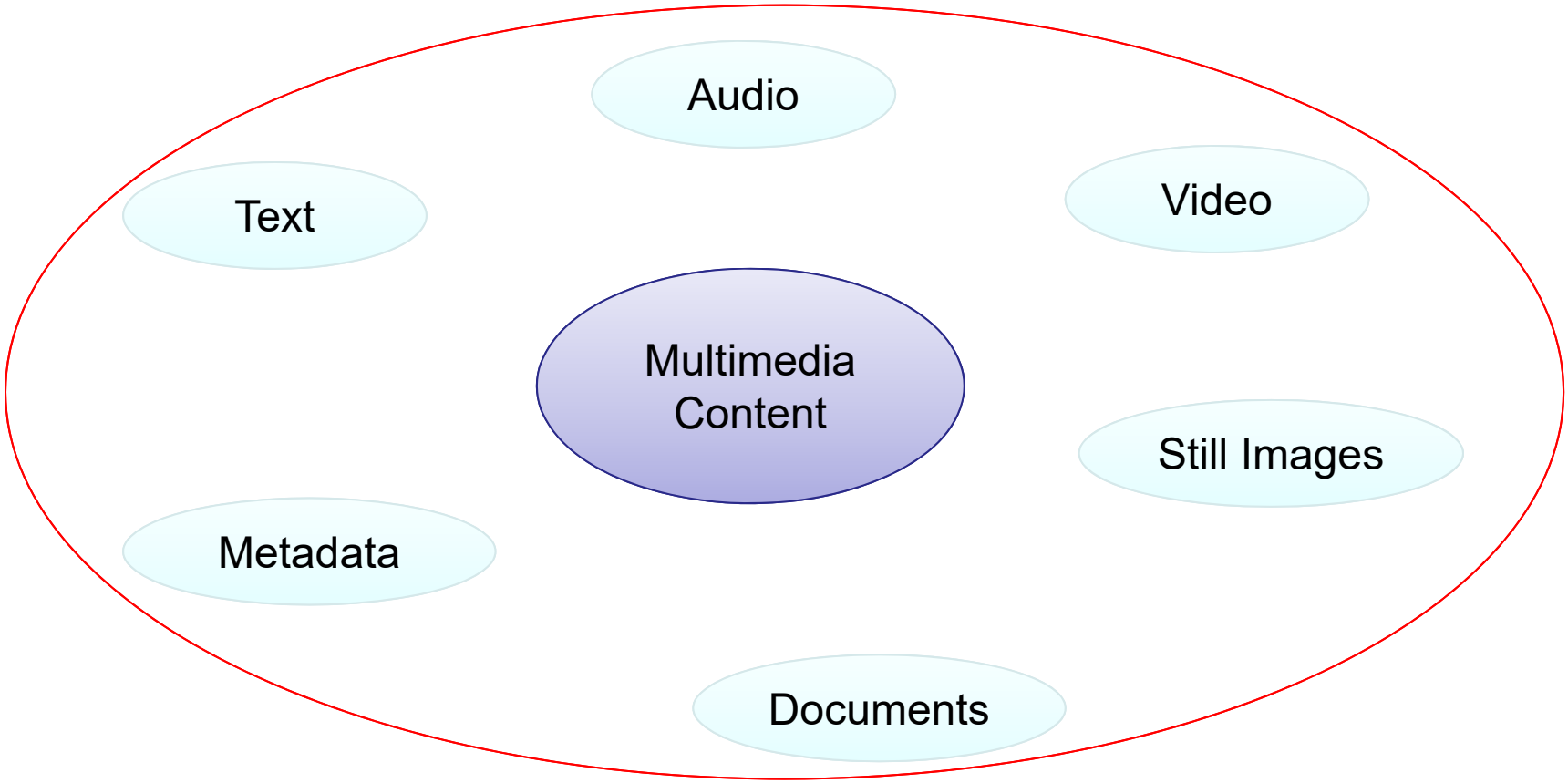
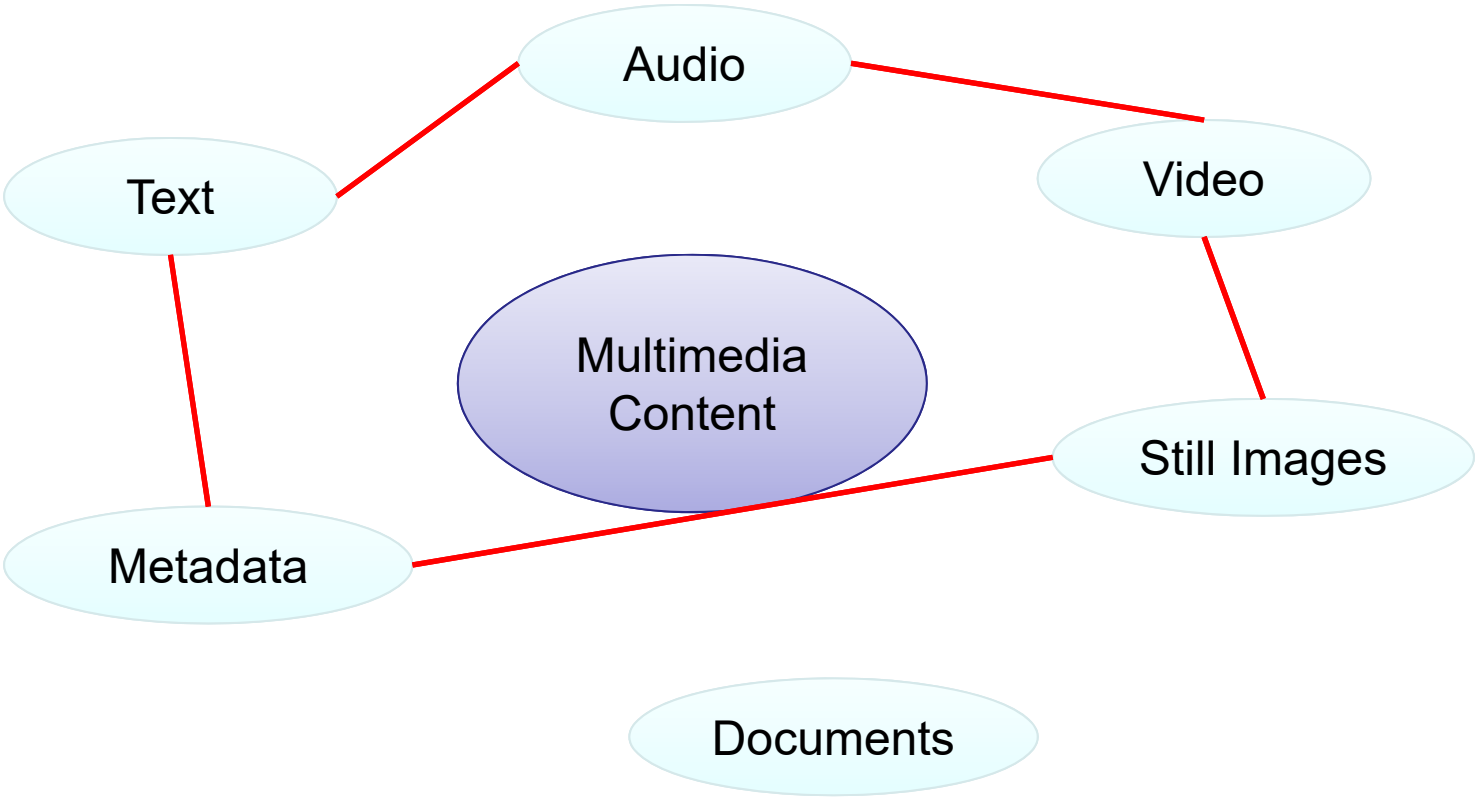


Multimedia Content, what is it?



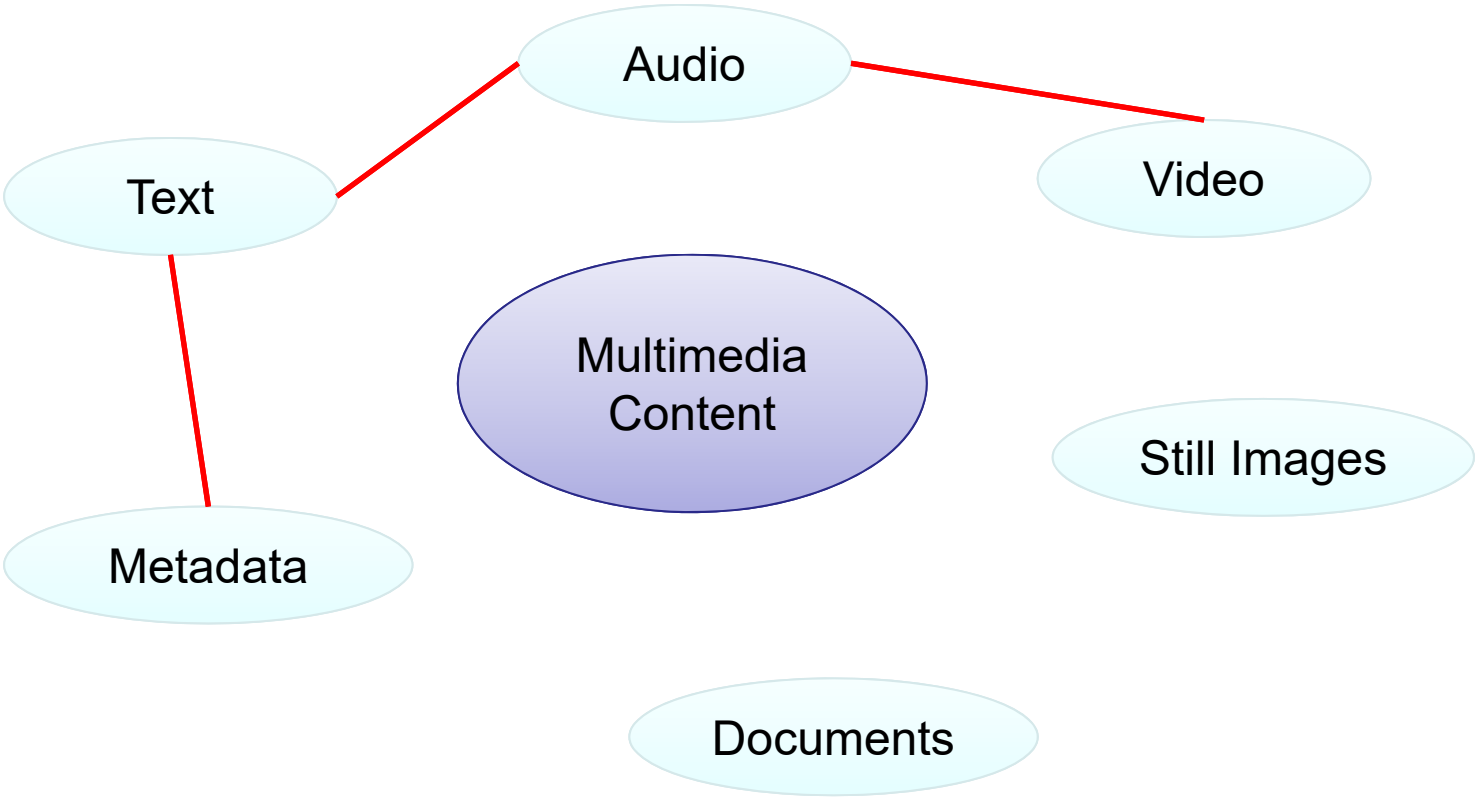
Monomedia content can be combined in different ways to provide different kind of multimedia content

MM Content, some examples



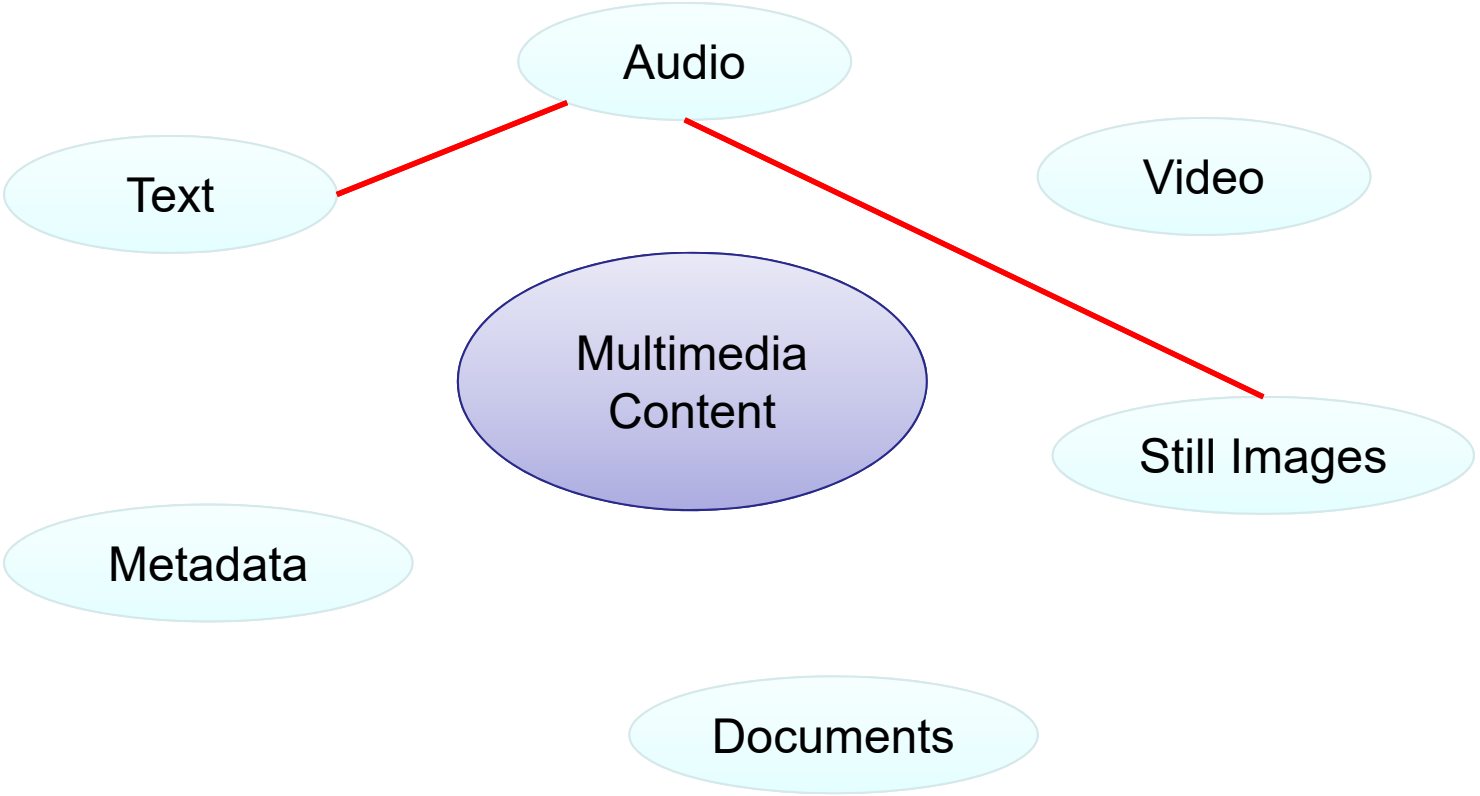
DVD: Includes audio and video tracks, metadata, still images for the cover and text for subtitles

MM Content, some examples



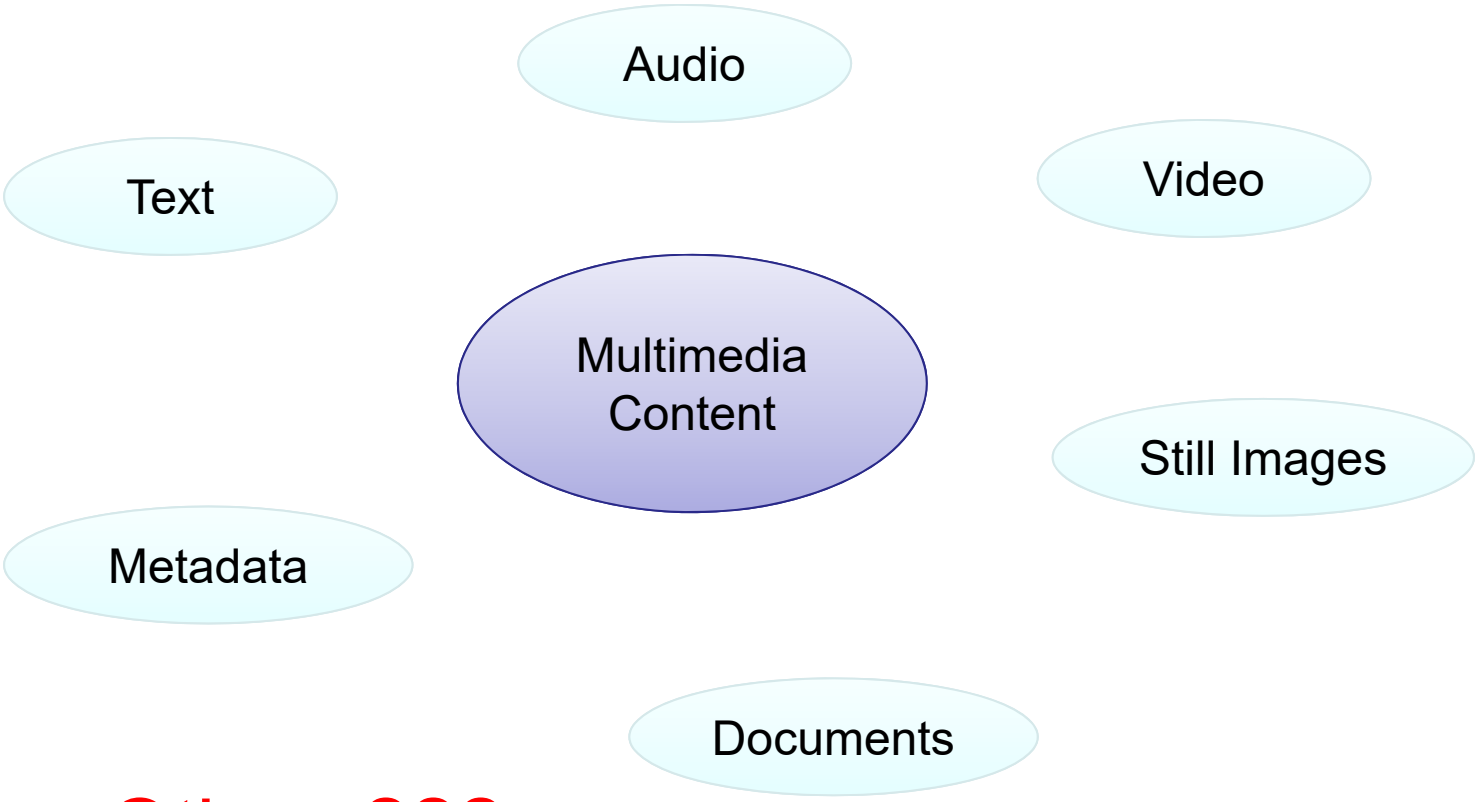
Streamed movie: Includes audio and video tracks and text for subtitles. Metadata could be also included.

MM Content, some examples



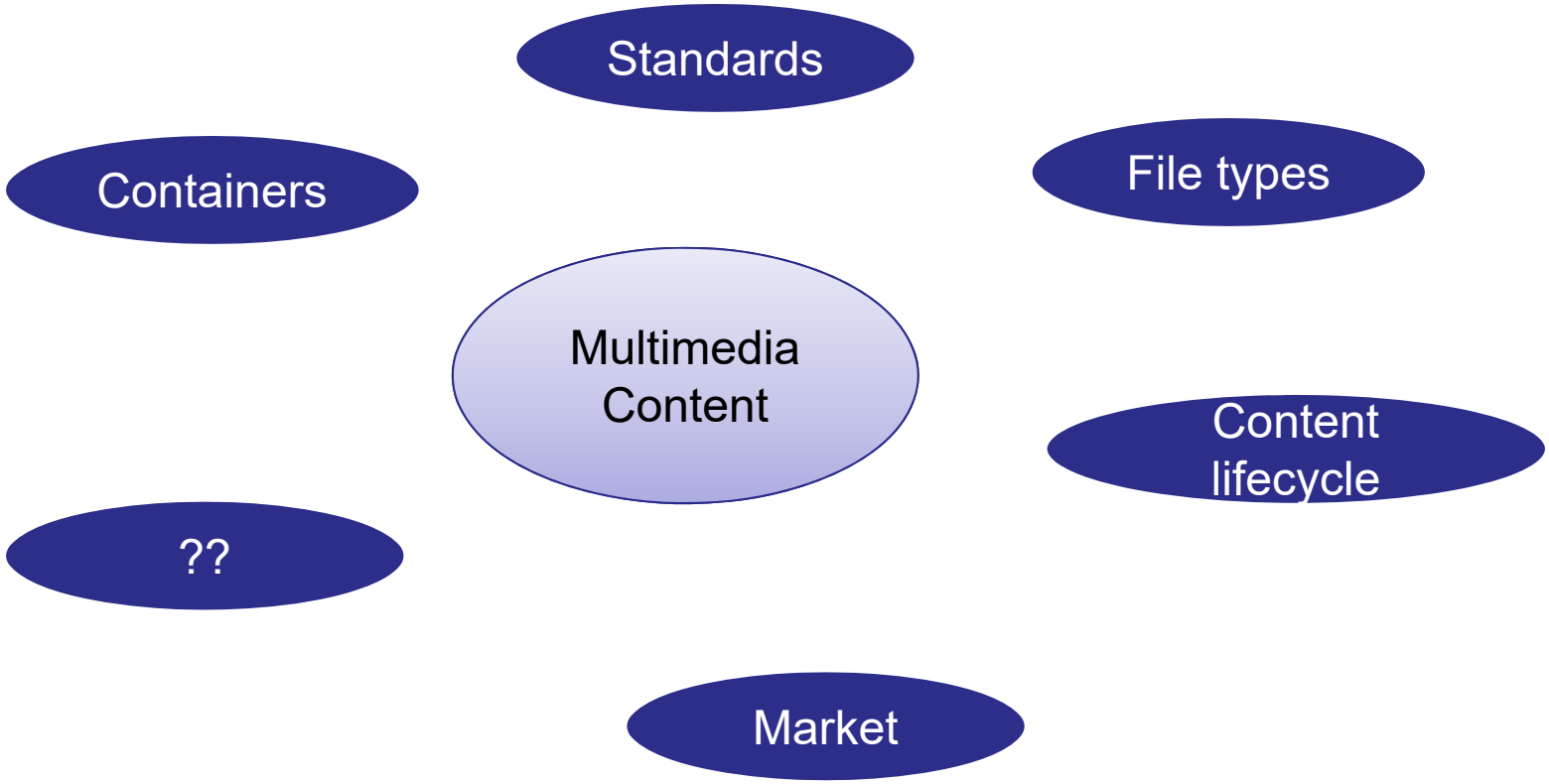
Video with only music in Youtube: Audio and still images (to be presented by the player during audio playback)

MM Content, some examples

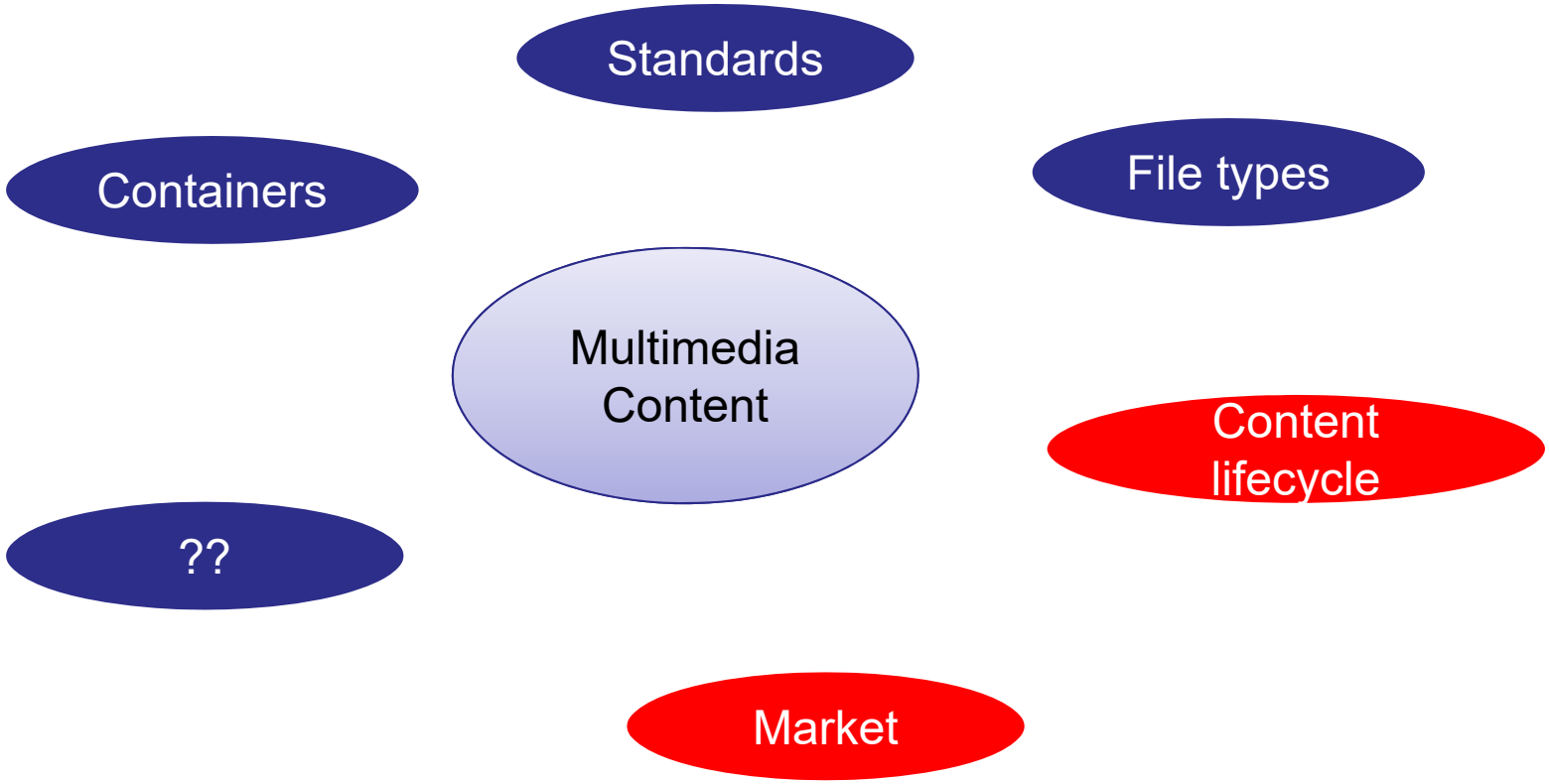


Others???

Some more concepts in MM



Some more concepts in MM



Multimedia content

Content Lifecycle

- Creation
- Storage
- **Processing**
- Distribution
- (Preservation)
- Deletion

Multimedia content: Processing

- ***Use***

- CRUD → (Create) Read Update (Delete)

- Read: Access, “render” (play, reproduce, …)
- Update: Transform, Combine, *Manipulate*
- Copy? Replace?
- …

Multimedia content

Content Lifecycle

- Creation
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Elements

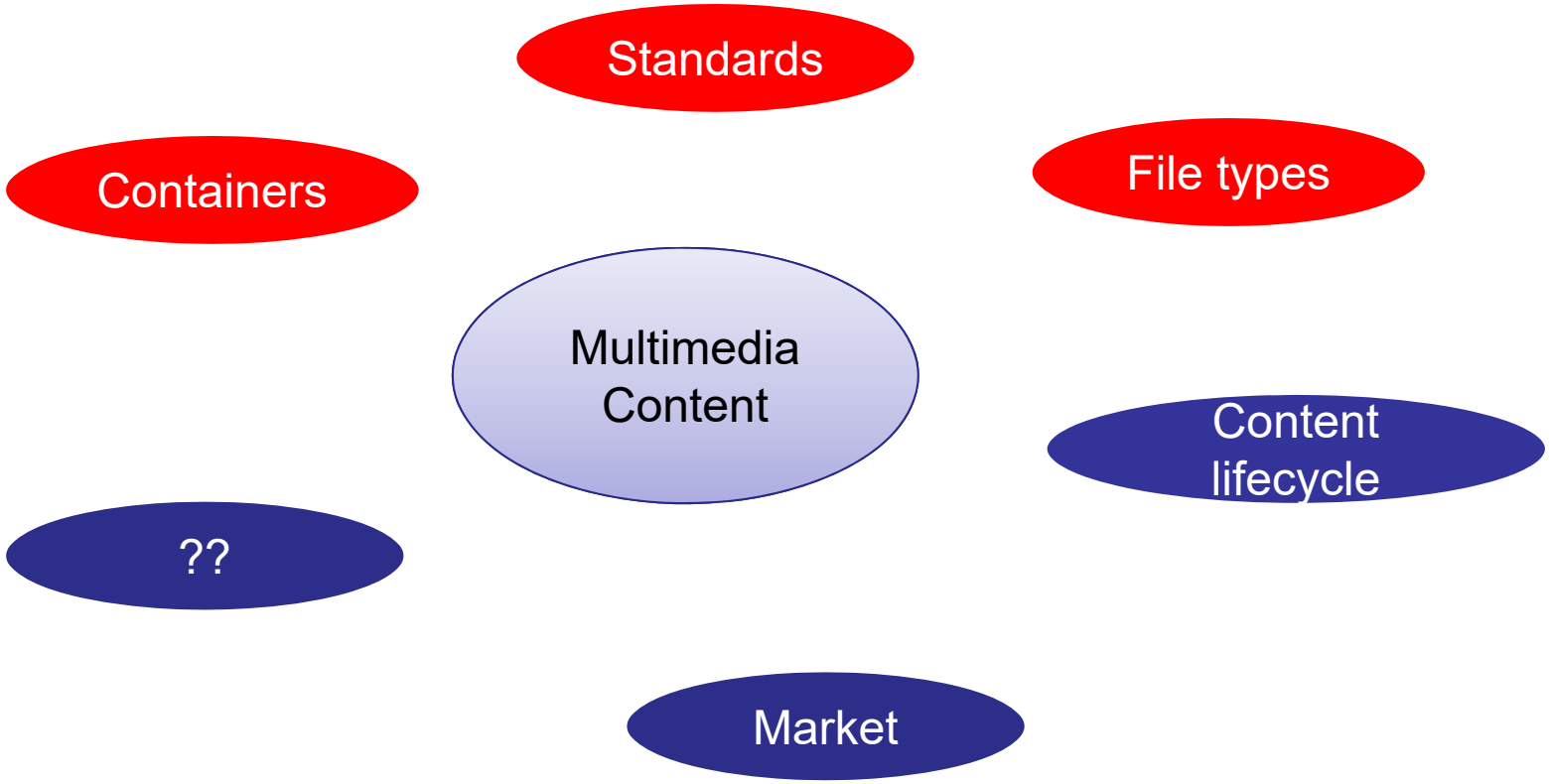
- Identification
- Description (Metadata)
- Coding
- Transfer (Comm. protocols)
- Search
- *Business Models*
- Digital Rights Management

- **Information (Formats: Metadata + Resources)**
- **Operations (Protocols, Dialogue)**

Market – Distribution / Usage

- Content Management Systems (CMS)
- Content Delivery Networks (CDN)
- Music/Radio
- Mobile Video
- Online Video Platforms
- OTT (Over The Top) Video
- (Video) Advertising
- (Video) Content Protection/DRM (Digital Rights Management)
- (Video) Creation/Production
- (Video) Encoding/Transcoding
- (Video) Formats/Players/Codecs
- (Video) Hosting/Delivery
- (Video) Legal Issues
- (Video) SEO (Search Engine Optimization)

Some more concepts in MM



Multimedia content

- Content architectures
  - Concepts
  - Classification
- Content types
  - Characters
  - Audio
  - Images
  - Video
- Structures and containers
- Metadata

Content architectures

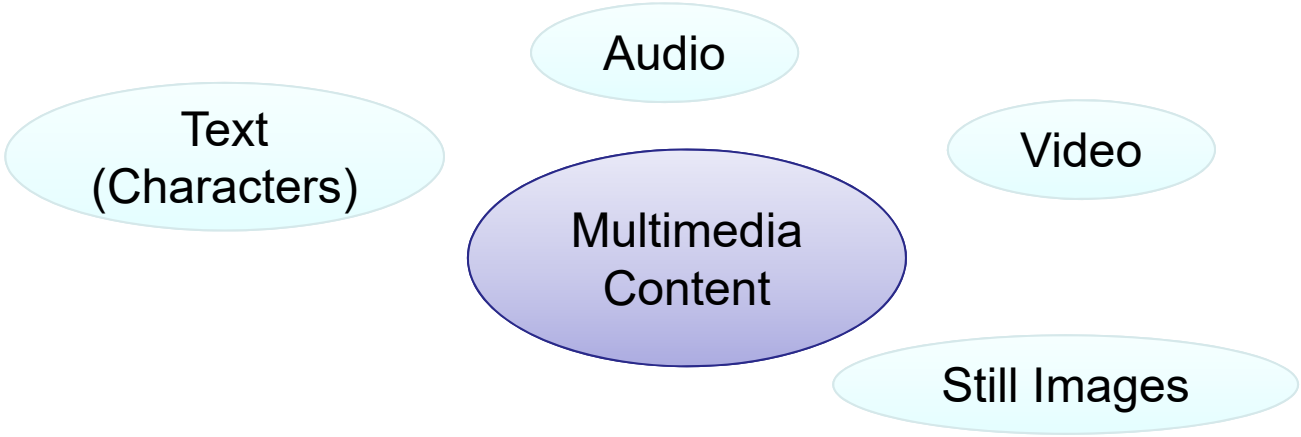
- Classification: Based on what?
- Concepts to consider:
  - Monomedia vs. Multimedia
  - Monomedia content types
  - Captured/Scanned vs. Synthetized
  - Space, time, … (dimensions)
  - …

Content in Audiovisual Systems

- Hearing – Vision.
- Audio, Image+Video (“Multimedia”)
- Text (characters): No multimedia!

Content architectures

- A first simple classification:
  - Characters
  - Audio
  - Image
  - Video



Content architectures

- Classification - A refinement/variation:
  - Characters (text)
  - Audio/Sound
  - Still Images
  - Graphics:
    - Image (raster graphics, pixels)
    - Graphics (vector)
  - Video (moving images)
  - Animation (moving vector images)

Bibliography: https://vector-conversions.com/vectorizing/raster_vs_vector.html

Content architectures

- Another approach (Media (formerly MIME) Content types):
  - application
  - audio
  - font
  - example
  - image
  - message
  - model
  - multipart
  - text
  - video

Official list: https://www.iana.org/assignments/media-types/media-types.xhtml

Multimedia content

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  - **Characters**
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Characters vs. Text

- Characters: Monomedia
- Text:
  - "Plain" (characters)
  - "Rich" (format, structure) → Documents

- Documents:
  - Multimedia structures
  - Logical and physical (layout) structure
  - Presentation

- **We focus on characters**

Characters

- Coding / representation
- Visualization: Fonts, …
- Character Sets:
  - ASCII → ISO 646.
  - ISO 2022:
    Variable width encoding (7-8 bits bytes).
    Multiple char sets. Escape chars.
  - ISO/IEC 8859 (8-bit printable chars encodings).
  - UCS (Universal Character Set)
    - ISO/IEC 10646
    - Aligned to **UNICODE**
    - **UTF-x** concept

Characters

- Some resources
  - http://unicode.org/charts/
  - https://unicode-table.com/es/
  - http://www.ltg.ed.ac.uk/~richard/utf-8.html

Unicode Characters

- A **character** is a symbol that appears in a text
  - letters of the alphabet
  - pictograms (like ©)
  - accents
- Unicode characters are abstract entities:
  - `LATIN CAPITAL LETTER A`
  - `LATIN CAPITAL LETTER A WITH RING ABOVE`
  - `HIRAGANA LETTER SA`
  - `RUNIC LETTER THURISAZ THURS THORN`

Hiragana letter SA

Runic letter Thurisaz Thurs Thorn

Unicode Glyphs

- A **glyph** is a graphical presentation
- A typical example is: Å
- This may represent several characters:
  - `LATIN CAPITAL LETTER A WITH RING ABOVE`
  - `ANGSTROM SIGN`
- Or even a sequence of characters:
  - `LATIN CAPITAL LETTER A`
    `COMBINING RING ABOVE`
- Some characters even result in several glyphs

Unicode Code Points

- A **code point** is a unique number assigned to every Unicode character
- Code points are between 0 and 1,114,112
- Only around 100,000 are used today
- The character `HIRAGANA LETTER SA` is assigned the code point 12,373
- Code point 0 through 127 coincide with ASCII
- Some code point are never assigned

Unicode Character Encoding

- A **character encoding** interprets a sequence of bytes as a sequence of code points
- The bytes are first parsed into **code units**
- Code units have a fixed length
- One or more code units may be required to denote a code point
- Examples are UTF-8, UTF-16, UTF-32

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Audio/Sound

- One dimension.
- “Speach” or not. Frequency ranges.
- Natural (recorded) or generated.
- Structured (“symbols”).
- Coding and compression formats.

Audio compression/coding

- General mechanisms:
  - Pulse Code Modulation (PCM) (voice)
  - Differential and adaptive (ex. (Adaptive) Differential Pulse Code Modulation (A)DPCM)
  - Psychoacoustics (ex. MPEG)

- Music-specific mechanisms :
  - MIDI (Musical Instrument Digital Interface)

Audio compression/coding

- Voice-specific mechanisms:
  - CELP (Code Excited Linear Prediction):
    - Voice generation system emulation
  - CS-ACELP (Conjugate-Structure Algebraic CELP)
  - LPC (Linear Prediction Coding)
    - Voice model → Synthetize
  - GSM (Mobile)

Audio compression/coding

- Basic ideas:
  - Sample frequency (f_s).
  - Bandwidth. Sampling theorem.
  - Bits per sample (b_s).
  - Logarithmic and linear values.
  - Flow Rate ($R=f_s*b_s$ bps)
  - Examples:
    - Telephony: R=8KHz*8bits= 64Kbps
    - Music CD: R=44,1KHz*16bits =1,411 Mbps
  - 1 KHz → 1000 samples per second

Audio standards

- Telephony/Speech – audio without compression:
  - PCM (Pulse Code Modulation). Logarithmic.
  - G.7xx
- Music:
  - CD-DA (Compact Disc – Digital Audio). Lineal PCM.
    → 1,411 Mbps (CD-ROM x1)
  - DVD-Audio → 9,216 Mbps
- Broadcasting/video:
  - Based on human hearing (perception)
  - MPEG-1 Layer III (mp3)
  - MPEG-2 AAC (Advanced Audio Coding)
  - Vorbis: Open source competing with mp3/AAC

mp3 file format

An MP3 File

Internal Structure of an MP3 File

MP3 Header
MP3 Data
MP3 Header
MP3 Data
+++ Repeated +++
MP3 Header
MP3 Data
MP3 Header
MP3 Data

Note that the MP3 file structure may be 'encapsulated' within an ID3 tag.

ID3v2x Metadata
MP3 Header
MP3 Data
MP3 Header
MP3 Data
+++ Repeated +++
MP3 Header
MP3 Data
MP3 Header
MP3 Data

An MP3 Frame

MP3 Header
MP3 Data

Example MP3 Header

FF FB A0 40 Colour-coding shows binary bit mapping to hex values below

Detail of an MP3 Header

Bits	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Binary	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	0	1
Hex	F			F			F							B			A						0			
Meaning	MP3 Sync Word												Version	Layer		Error Protection	Bit Rate				Frequency		Pad. Bit	Priv. Bit	Mode	
Value	Sync Word												1 = MPEG	01 = Layer 3		1 = No	1010 = 160				00 = 44100 Hz		0 = Frame is not padded	Unknown	01 = Joint Stereo	

	27	28	29	30	31	32
	0	0	0	0	0	0
	4				0	
	Mode Extension (Used With Joint Stereo)		Copy	Original	Emphasis	
	0 = Intensity Stereo Off	0 = MS Stereo Off	0 = Not Copy-righted	0 = Copy Of Original Media	00 = None	

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Images

- 2 dimensions
- Still images
- Raster/Pixels/Bitmap vs. Vector
- Vector graphics:
  - Geometric objects
    (lines, polygons, circles, ellipses, curves, …)

Vector graphics formats

Standards:

- CGM. Computer Graphics Metafile. (File format / container). ISO/IEC 8632. `image/cgm`
- SVG. Scalable Vector Graphics. XML based. W3C. (May include raster graphics). `image/svg+xml`
- …

Proprietary:

- Adobe Illustrator. `application/illustrator`
- CorelDRAW. `application/coreldraw`
- …

Images

- Raster
- Capture/Scanning vs. Synthesis
- Bits per pixel (“depth”)
- Formats/Standards for images

Image formats

Standards:

- JPEG. ISO/IEC 10918-1 / ITU-T T.81. `image/jpeg`
- JPEG2000. ISO/IEC 15444. `image/jpeg2000`
- JPEG XR. eXtended Range. ISO/IEC 29199 / ITU-T T.83x. `image/vnd.ms-photo`
- JPEG XT. eXTensions (compatible). ISO/IEC 18477. Includes HDR (High Dynamic Range).
- DPX. Digital Picture Exchange. ANSI/SMPTE standard (268M-2003). `image/dpx`
- "RAW": raw image format. Example: ISO 12234-2, Tag Image File Format / Electronic Photography (TIFF/EP).

Image formats

Proprietary (but open):

- BMP. Microsoft Windows bitmap. `image/bmp`
- GIF. Graphics Interchange format. CompuServe. `image/gif`
- WebP. Google. 2010! Smaller files some concerns about image quality.

Webp concerns: https://optimus.keycdn.com/support/webp-support/

Image file formats / containers

- JFIF. JPEG file format.
- PNG. Portable Network Graphics. Donated to W3C. ISO/IEC 15948, RFC 2083. `image/png`
- TIFF. Tagged Image File Format. Adobe. `image/tiff`
- GIF. Graphics Interchange Format. Compuserve. `image/gif`

Exif file header: https://www.media.mit.edu/pia/Research/deepview/exif.html

JPEG file interchange format (JFIF) header

```
typedef struct _JFIFHeader
{
  BYTE SOI[2];           /* 00h  Start of Image Marker     */
  BYTE APP0[2];          /* 02h  Application Use Marker    */
  BYTE Length[2];        /* 04h  Length of APP0 Field      */
  BYTE Identifier[5];    /* 06h  "JFIF" (zero terminated) Id String */
  BYTE Version[2];       /* 07h  JFIF Format Revision      */
  BYTE Units;            /* 09h  Units used for Resolution */
  BYTE Xdensity[2];      /* 0Ah  Horizontal Resolution     */
  BYTE Ydensity[2];      /* 0Ch  Vertical Resolution       */
  BYTE XThumbnail;       /* 0Eh  Horizontal Pixel Count    */
  BYTE YThumbnail;       /* 0Fh  Vertical Pixel Count      */
} JFIFHEAD;
```

- SOI Start Of Image (FFh D8h)
- APP0 Application marker for JPEG (FFh E0h)
- Length: JFIF segment size, including header and thumbnails
- Identifier: identifies a code stream following JFIF specification (4Ah 46h 49h 46h 00h)
- JFIF specification version
- Units, Xdensity & Ydensity identify the measuring units that define the resolution of the image and the horizontal and vertical sizes.
- Xthumbnail & Ythumbnail define the size of a thumbnail included with the image. If no thumbnail, then 0.

Editor hexadecimal: https://www.onlinehexeditor.com/

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Video

- 3 dimensions (2D + time)
- “Moving images”
- Animation = “moving vector graphics”
- Capture vs. Synthesis

- Series of “frames” (raster images)
  → Frames per second.

- Compression/Coding

- 3D video

Video compression formats

- Color: RGB → luma + chroma (2); subsampling
- TV: ITU-R Rec. 601 (1982!)
- Pure sequence of images (spatial compression):
  - M-JPEG, M-JPEG2000
- MPEGs (+ temporal compression; I-, P- & B-frames)
- Others:

Video compression formats

- Color: RGB → luma + chroma (2); subsampling
- TV: ITU-R Rec. 601 (1982!)
- Pure sequence of images (spatial compression):
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- **MPEGs** (+ temporal compression; I-, P- & B-frames)
- **Others:**

Video compression formats

- MPEGs (+ temporal compression; I-, P- & B-frames):
  - MPEG-1 (ISO/IEC 11172)
  - MPEG-2 (ISO/IEC 13818) / ITU-T H.262
  - MPEG-4 part 2 “visual” (objects) (ISO/IEC 14496) (ASF profile compatible with H.263)
  - AVC (MPEG-4 part 10 / H.264)
  - HEVC (MPEG e ITU-T): The newest one.
  - *(H.261, H.263; transmission, videoconferencing)*

Video compression formats

- Others:
  - VP8 (Google) Open Source. RFC6386.
  - VP9 (Google)
  - VP10 → Moved to AV1
  - AV1 (Alliance for Open Media) → Browser vendors, service providers, etc.

Bibliography:

https://aomedia.org/
https://bitmovin.com/av1/

HEVC (High Efficiency Video Coding)

- New video compression standard.
- JCT-VC (Joint Collaborative Team on Video Coding):
  Joint MPEG (ISO/IEC JTC1 SC29/WG11) and
  ITU-T VCEG (Video Coding Experts Group).
- ISO/IEC 23008-2 MPEG-H / ITU-T H.265.
- Improvement over MPEG-4 AVC:
  - Double data compression for the same quality, or
  - better quality for the same bit rate.
- High resolutions:
  Ultra HD TV 8K support (up to 8192 × 4320).

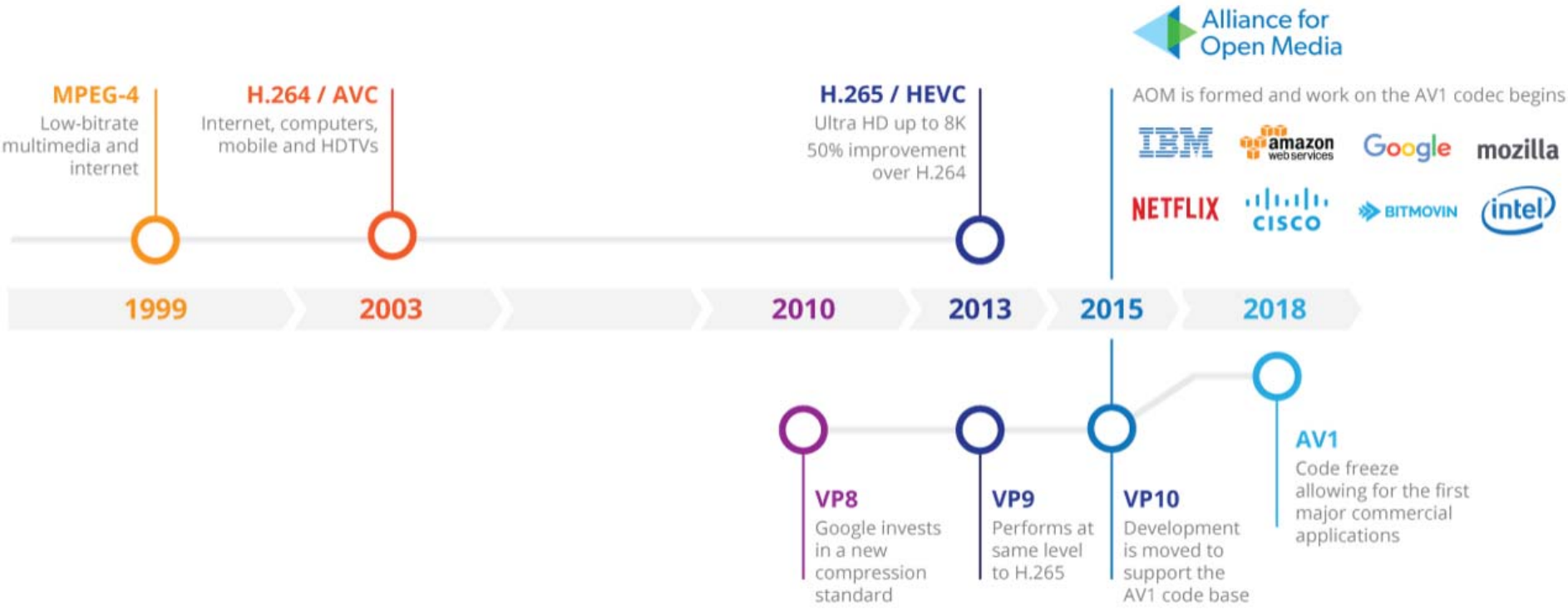
HEVC (High Efficiency Video Coding)

- 25th January 2013: ISO/IEC FDIS / ITU-T Consent
- Extensions under development:
  - range extensions (supporting enhanced video formats),
  - scalable coding extensions,
  - 3D Video extensions,
  - …
- Still under development, amendments on 2017
  - https://www.iso.org/standard/75484.html

- Comparable to Google VP9 → YouTube

AV1

- Open, royalty-free, video coding format from the Alliance of Open Media Video.
- Expected improvement of 30 % over VP9/HEVC



Video quality examples

Quality	Frames/ second	Bits/ pixel	Resolution	Uncompressed flow-rate
CIF (VHS)	25	12	352 x 288 (100 Kpixels)	30 Mbps
SD PAL / NTSC	25 / 30 (29,97)	16	720 x 576 / 720 x 480 (415 / 346 Kpixels)	166 Mbps
HD 720p	25	24	1280 x 720 (922 Kpixels)	553 Mbps
HD 1080p	25	24	1920 x 1080 (2,1 Mpixels)	1244 Mbps
Dig. cinema 2K	24 / 48	36	2048 x 1080 (2,2 Mpixels)	3822 Mbps *(48 fps)*
Dig. Cinema / UHD 4K	24	36	4096 x 2160 (8,8 Mpixels)	7644 Mbps
UHD TV 8K	48 / 96	36	Exs.: 8192 x 4320 (16:9) **7680 x 4320** (35,3 / 33,1 Mpixels)	122 Gbps

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- **Structures and containers**
- Metadata

Structures and containers

- *Structures → Documents*
- Containers → Multimedia containers
- Files → File formats
- Information:
  - Audio streams
  - Video streams
  - Synchronization info
  - Metadata
  - Complementary info: subtitles, chapters, …
- Parts:
  “chunks”, “atoms”, “packets”, “segments”, …
  contain the “payload” (data)

Multimedia containers

- ***Specific and generic***

- Specific:
  - Audio: WAV (Microsoft/IBM), Ogg Vorbis, …
  - Images / Graphics: many!, …
  - Compound “graphic” structures:
    PDF, EPS, RTF, …

Multimedia containers

- **Generic (multimedia)**
  Proprietary
  - Microsoft/IBM: RIFF (Resource Interchange FF)
  - Microsoft: ASF, AVI, …
  - Adobe: Flash video, …
  - Google: WebM (VP8+Vorbis for HTML5). (Based on Matroska)
  - Xiph.org: ogg (Theora+Vorbis for HTML5).
  - Matroska (.mkv)
  - …

WebP uses RIFF.
WAV, AVI, etc. are derived from RIFF.

Multimedia containers

- **Generic (multimedia) Standard**
  - DVD Forum: VOB
  - 3GP * (mobile)
  - MJ2 * (Motion JPEG 2000)
  - MPEG-2 TS
  - MP4 * (MPEG-4 Parts 14&15)
  - MXF (Material eXchange Format), SMPTE (TV broadc.)
  - MPEG-21 *

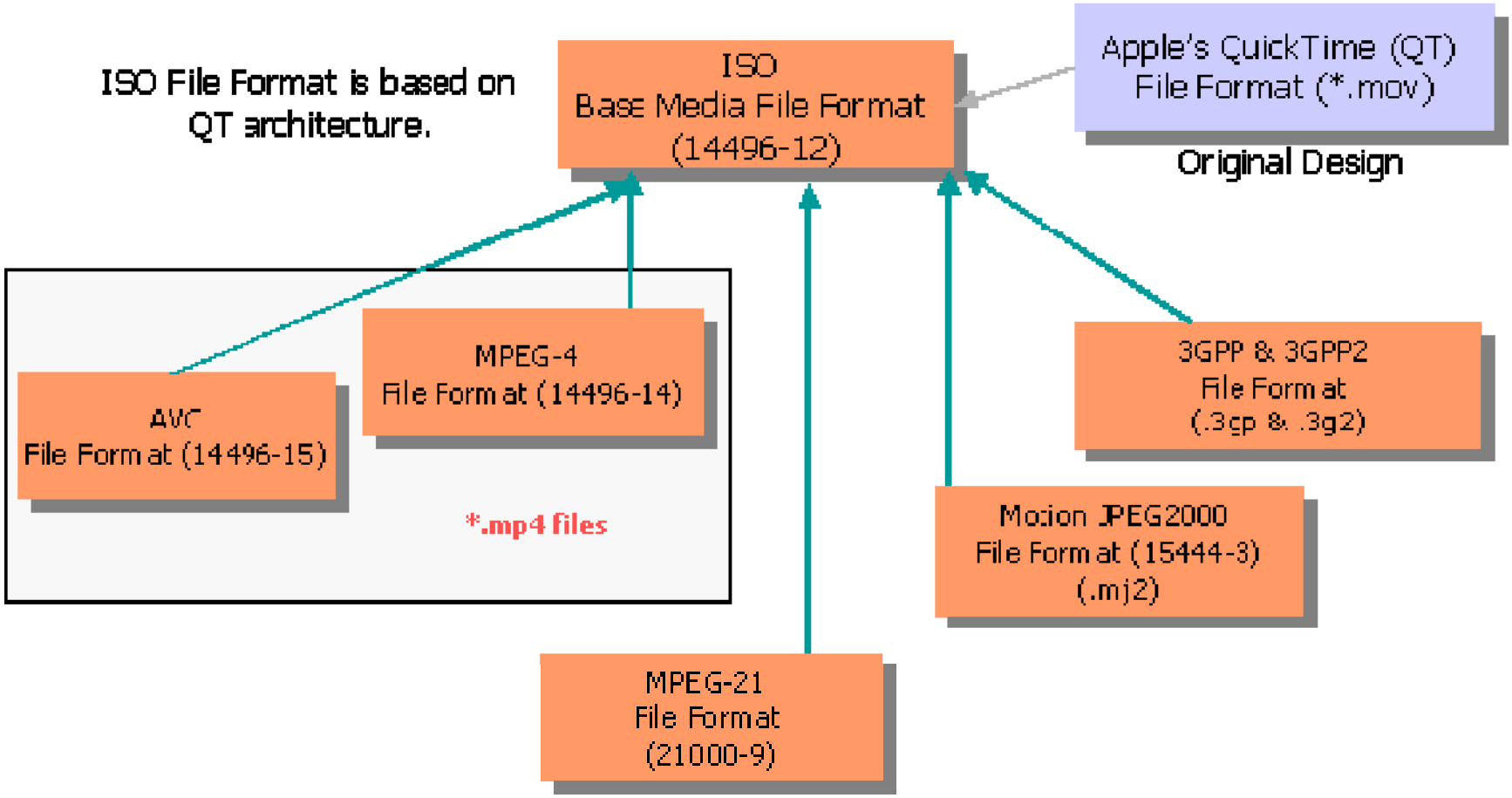
** Based on ISO base media file format*

Multimedia containers

- ISO base media file format
  - Format for different bitstreams
  - Specified in JPEG2000 and MPEG-4
  - Based on Apple Quick Time container
  - Specific extensions going on
  - Registration Authority for identifiers
  - Not all registered (Adobe Flash)

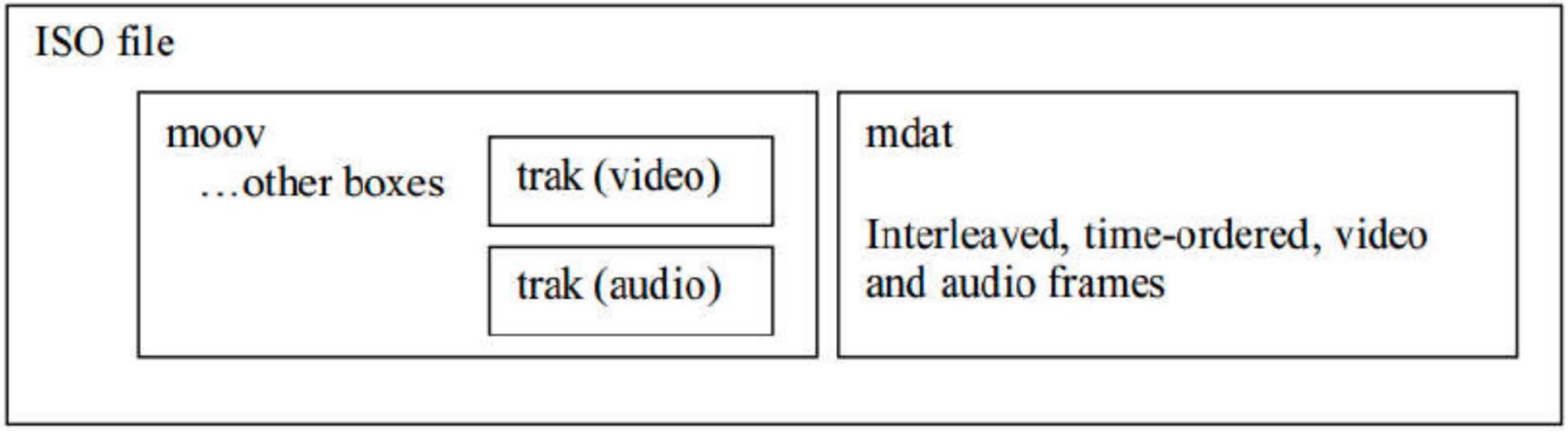
  - Object oriented structure
  - “Box” → File Type Box
  - Supports streaming

ISO base media file format



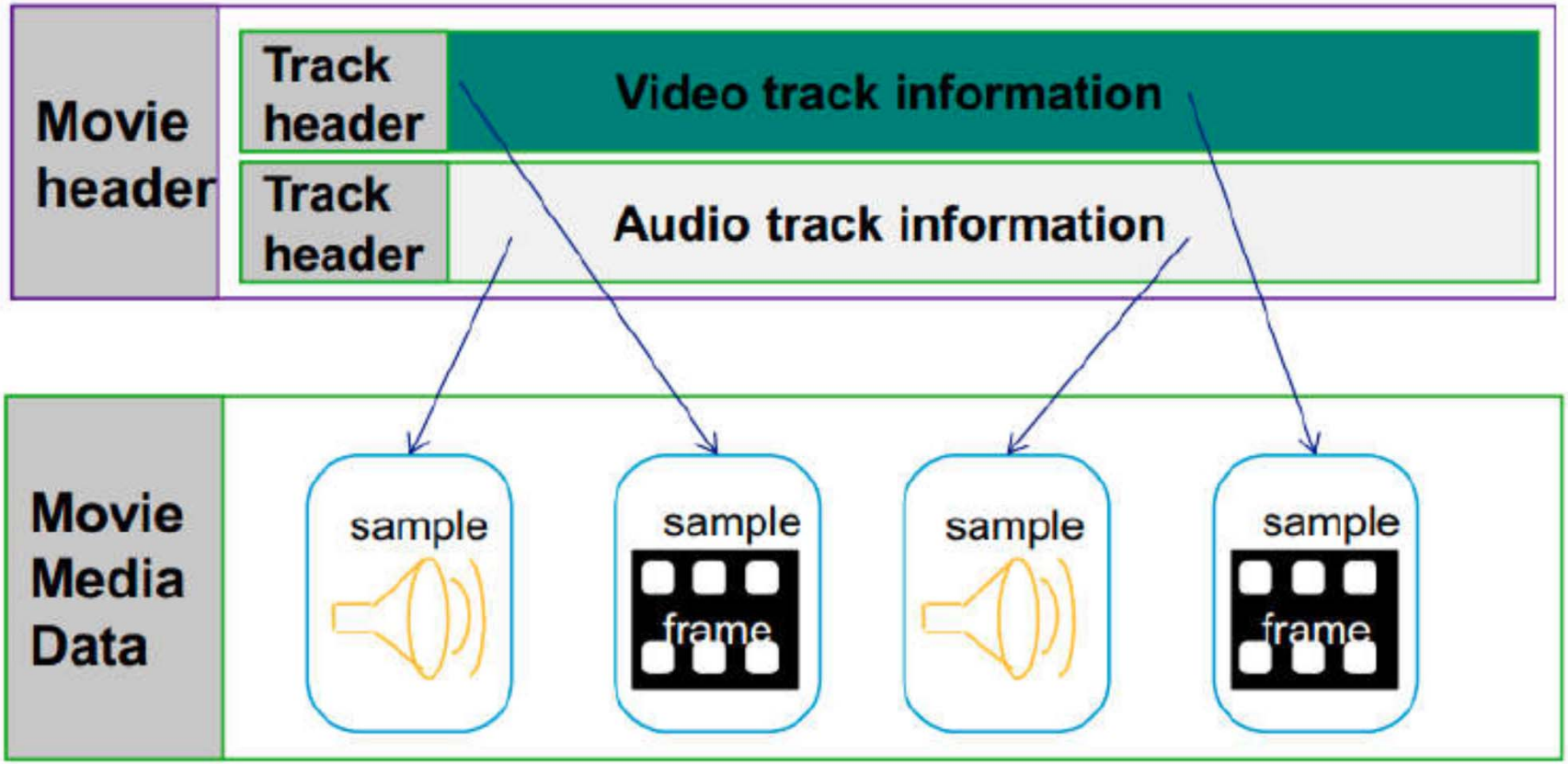
ISO Base Media File Format

- Hierarchical, Extensible
- Examples of boxes:
  - moov (Movie): timed data (A&V tracks, …)
  - mdat (Media Data): not structured
  - meta (Metadata)
  - mvhd (Movie Header)



ISO Base Media File Format

- Flexible. Example for a movie:



MPEG

Working Group ISO/IEC

Development of standards for coded representation of digital audio and video *(ISO/IEC JTC1 SC29/WG11)*

- **Moving Picture Experts Group**
  - MPEG-1: Standard for storage and retrieval of moving pictures and audio on storage media
  - MPEG-2: Standard for digital television
  - MPEG-4: Standard for multimedia applications
  - MPEG-7: Standard for description and search of audio and visual content
  - **MPEG-21: Multimedia Framework**

MPEG

Working Group ISO/IEC

Development of standards for coded representation of digital audio and video *(ISO/IEC JTC1 SC29/WG11)*

- **Moving Picture Experts Group**
  - MPEG-A (Application formats)
  - MPEG-B (Systems extensions)
  - MPEG-C (Video extensions)
  - MPEG-D (Audio extensions)
  - MPEG-H (MMT + HEVC)
  - MPEG-M (Middleware)
  - MPEG-V (Virtual “worlds”)
  - MPEG-DASH (Streaming)
  - MPEG-G (Genomics)
  - …

MPEG-21 parts (2018)

- Part 1: Vision, Technologies and Strategy
- Part 2: Digital Item Declaration
- Part 3: Digital Item Identification
- Part 4: Intellectual Property Management and Protection
- Part 5: Rights Expression Language
- Part 6: Rights Data Dictionary
- Part 7: Digital Item Adaptation
- Part 8: Reference Software
- Part 9: File Format
- Part 10: Digital Item Processing
- Part 11: Evaluation Tools for Persistent Association Technologies
- Part 12: Test Bed for MPEG-21 Resource Delivery
- Part 14: Conformance Testing
- Part 15: Event Reporting
- Part 16: Binary Format
- Part 17: Fragment Identification of MPEG Resources
- Part 18: Digital Item Streaming
- Part 19: Media Value Chain Ontology
- Part 20: Contract Expression Language
- Part 21: Media Contract Ontology
- Part 22: User Description

MPEG-21: Digital Items & Resources

- ISO/IEC 21000. Multimedia Framework
  - Interoperability of content delivering systems
  - Mechanisms to support the multimedia delivery chain

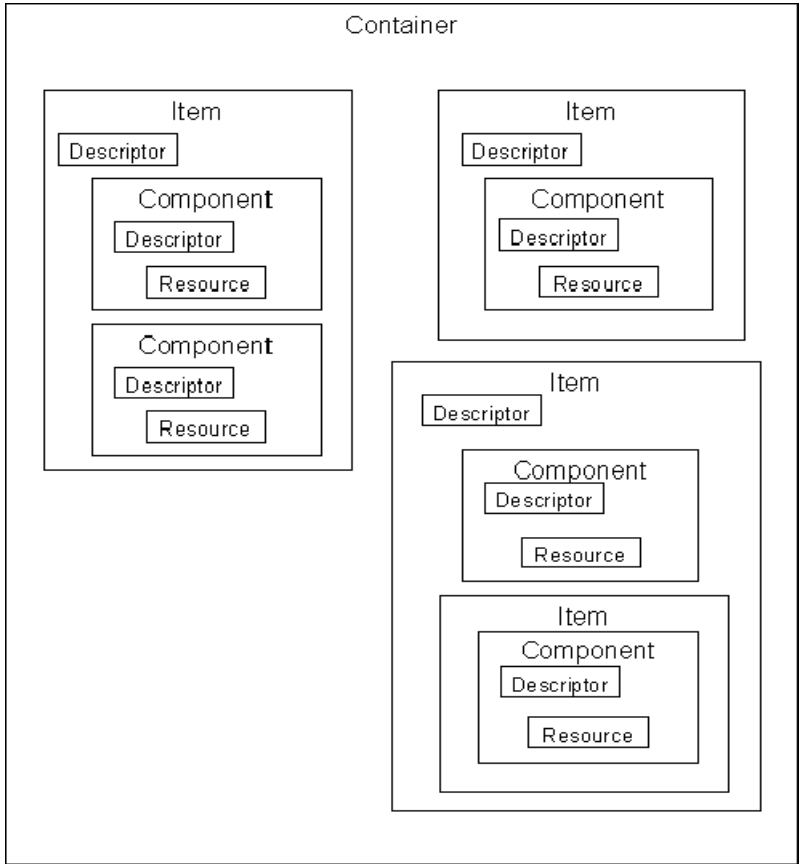
- MPEG-21 essential concepts
  - Digital Item (DI): unit of distribution and transaction.
    - Information in already existing representation formats
    - Associated metadata: description, adaptation, protection, rights
  - User: any entity that interacts with DIs

MPEG-21 Digital Item Declaration

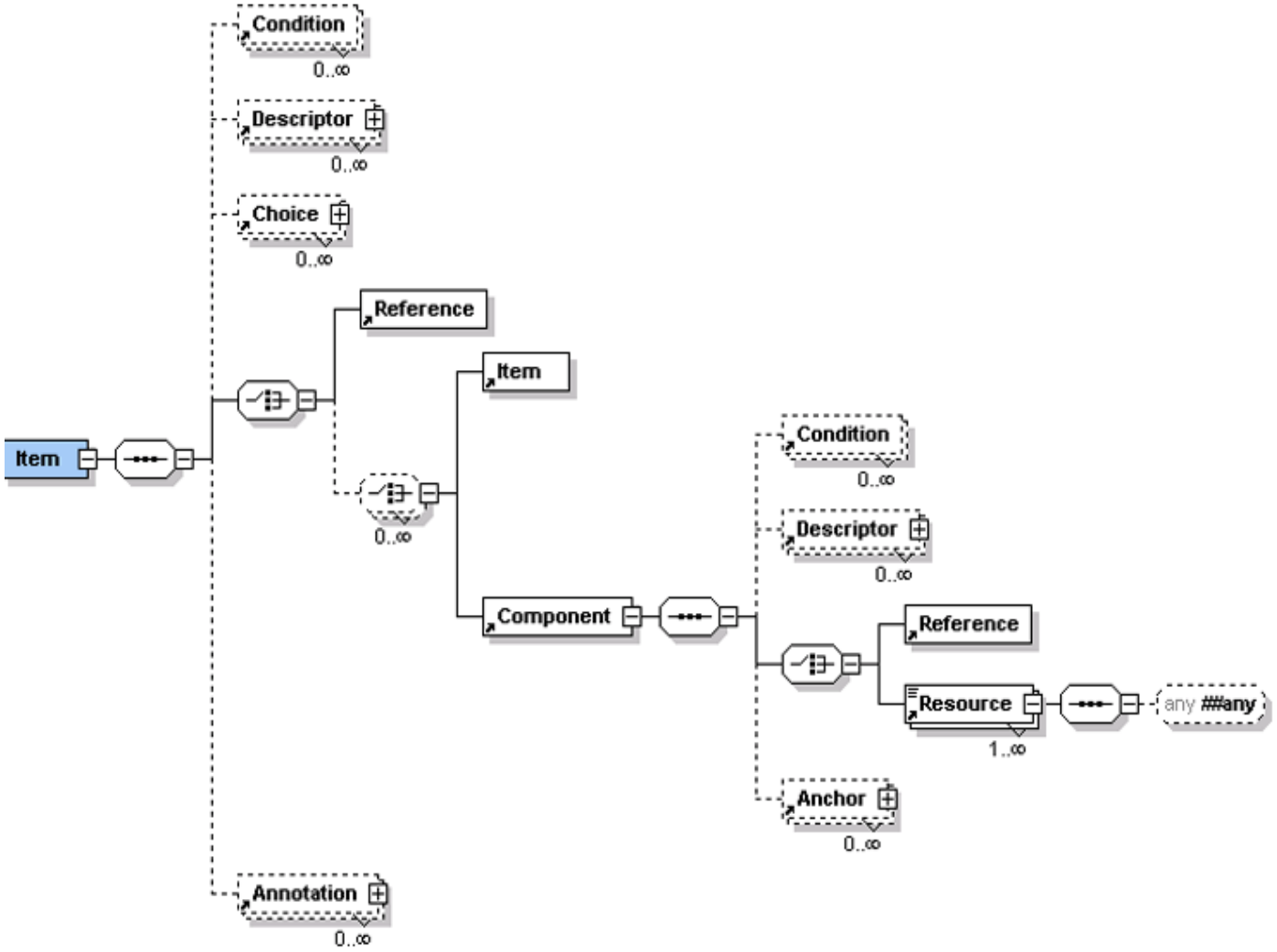
- DID Model
  - Abstract terms
  - Concepts

  → Model for defining Digital Items

Example DI



MPEG-21 DID Schema



Compression of genomic information

- New standard devoted to the compression and representation of genomic information
  - Coming from the bioinformatics field.
  - Compression required due to the huge amount of information. Currently text-based information.
  - Interdisciplinary approach: Biology, computer science, etc.
  - Privacy and security aspects.

Compression of genomic information

- Being discussed right now in Macau
  - Part 1: Transport layer of Genomic Information Representation
  - Part 2: Genomic Information Representation
  - Part 3: API for Genomic Information Representation
  - REVISAR

Multimedia content

- Content architectures
  - Concepts
  - Classification
- Content types
  - Characters
  - Audio
  - Images
  - Video
- Structures and containers
- **Metadata**

Media asset identification

- “Identification”
  before “Description” (Metadata)
- “Media asset” identification:
  - Unique (“registered” → *Registration Authority*)
  - To the external world
- Identification dependent on the object to identify
- Combine with:
  - metadata standards
  - container formats

Metadata

- “Data over data”
- “Data over multimedia resources/content”
- Example: Images

Metadata example

JPSearch Core Metadata Schema

- Identifier
- Title
- Description
- OriginalImageIdentifier
- Keyword
- CreationDate
- ModifiedDate
- RightsDescription
- Source
- CollectionLabel
- PreferenceValue
- Rating
- RegionOfInterest
- Modifiers
- Creators
- Publisher
- GPSPositioning
- Width
- Heigth

Metadata example

JPSearch Core Metadata Schema

- Identifier
- Title
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- Source
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- Width
- Heigth

EXERCISE: What is missing? What should be out?

Metadata - components

- **Schema** (categories of information)
- **Vocabulary** (specific ‘words' or ‘values’)
- **Conceptual model** (relationships between the information and concepts in a resource)
- **Content standard** (describe how specific information should be entered within metadata schema categories)
- **Encoding** (the way the metadata is presented, e.g. XML)

Metadata - components

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- **Vocabulary** (specific ‘words' or ‘values’)
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- **Encoding** (the way the metadata is presented, e.g. XML)

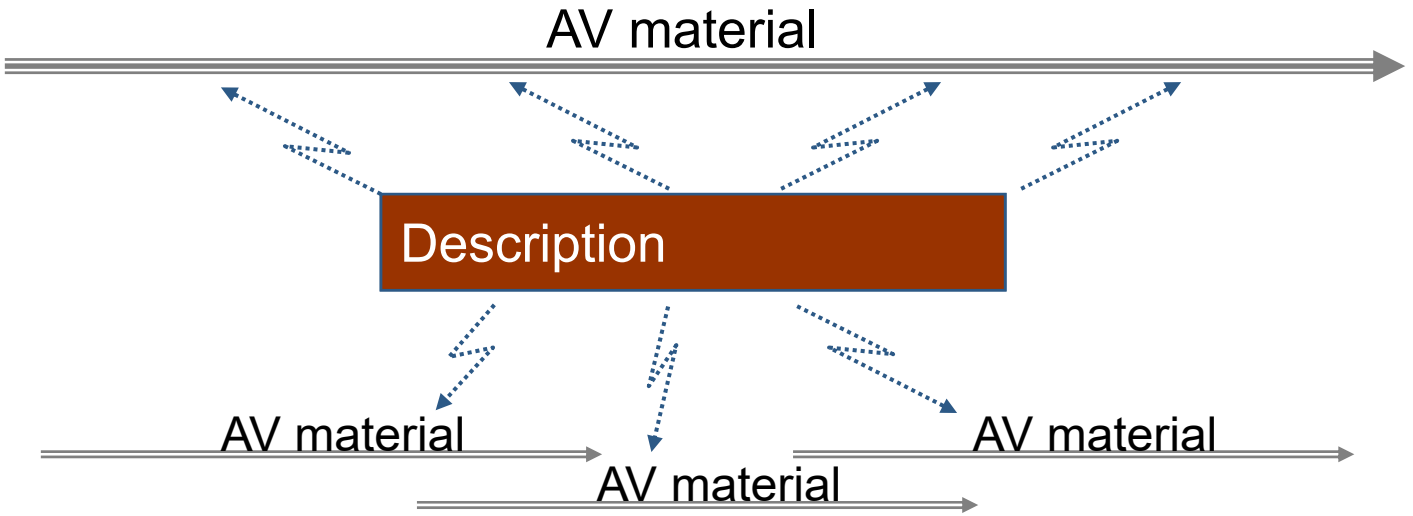
Metadata - Schemas

- Classification concepts:
  - *What is described*: audio, video, places, images, artistic images, books, …
  - *Application environment*: education, libraries, museums, archives, web, …
  - *Objective*: administration, description, search, interchange, preservation, …

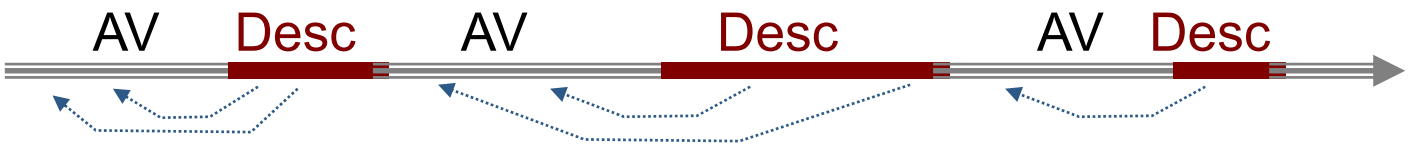
- “Embedded” or not.

Relation content / description

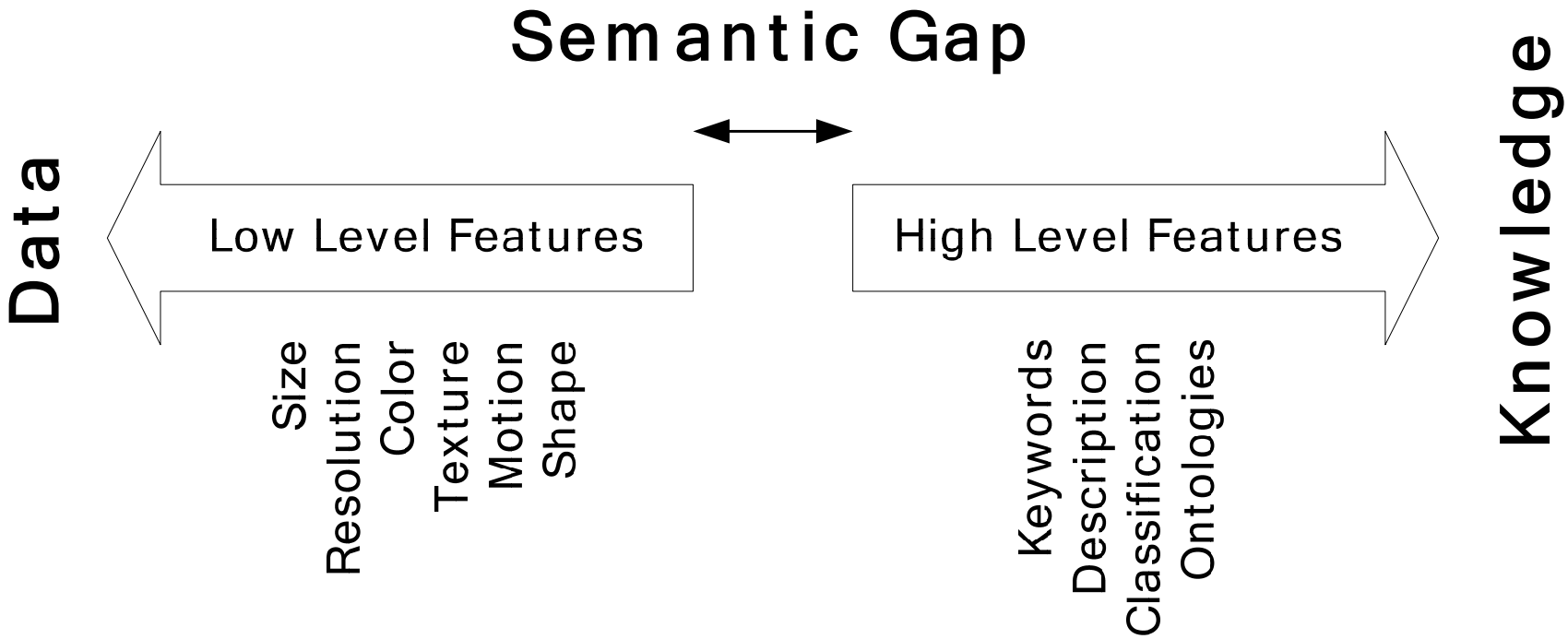
- Description may be separated from the content



- Description may be embedded in the content



Multimedia Metadata
Low level vs. high level features



Dublin Core (DC)

- One of most used schemas.
- Objective: “Set of 'core' metadata properties” for a basic description of resources (simple and compound).
- Generic: “Lowest common denominator”. Basic interoperability between “digital collections”.
- Official standard: ISO15836.
- Extension and adaptation mechanism:
  - **“Qualifier”**
  - **Extension**

Dublin Core (DC)

Element	Definition	Record A – a painting	Record B – a digital image
Title	Name by which the resource is formally known	Mona Lisa, La Gioconda	Mona Lisa, La Gioconda
Creator	An entity primarily responsible for making the content of the resource	Leonardo da Vinci	Leonardo da Vinci
Subject	The topic of the content of the resource	Woman, Portrait, Renaissance	Woman, Portrait, Renaissance
Description	An account of the content of the resource	Three-quarter portrait of a Florentine woman in front of a landscape	Three-quarter portrait of a Florentine woman in front of a landscape
Publisher	An entity responsible for making the resource	Musée du Louvre	[owner of digital collection]
Contributor	An entity responsible for making contributions to the content of the resource	N/A	Jane Smith [digital photographer]
Date	A date associated with an event in the life cycle of the resource	1500s	2002-10-30

Dublin Core (DC)

Type	The nature or genre of the content of the resource (e.g. sound, text, still image)	Still Image	Still Image
Format	The physical or digital manifestation of the resource (e.g. book, JPEG, PDF)	Oil painting	JPEG file
Identifier	An unambiguous reference to the resource within a given context	No.779 [museum inventory number]	2002_0054.jpg
Source	A reference to a resource from which the present resource is derived	N/A	Louvre No.779 [museum inventory number]
Language	A language of the intellectual content of the resource	N/A	N/A
Relation	A reference to a related resource	N/A	Record A
Coverage	The extent or scope of the content of the resource	77cm x 53cm	158KB
Rights	Information about rights held in and over the resource	Not in copyright	© [owner of digital collection]

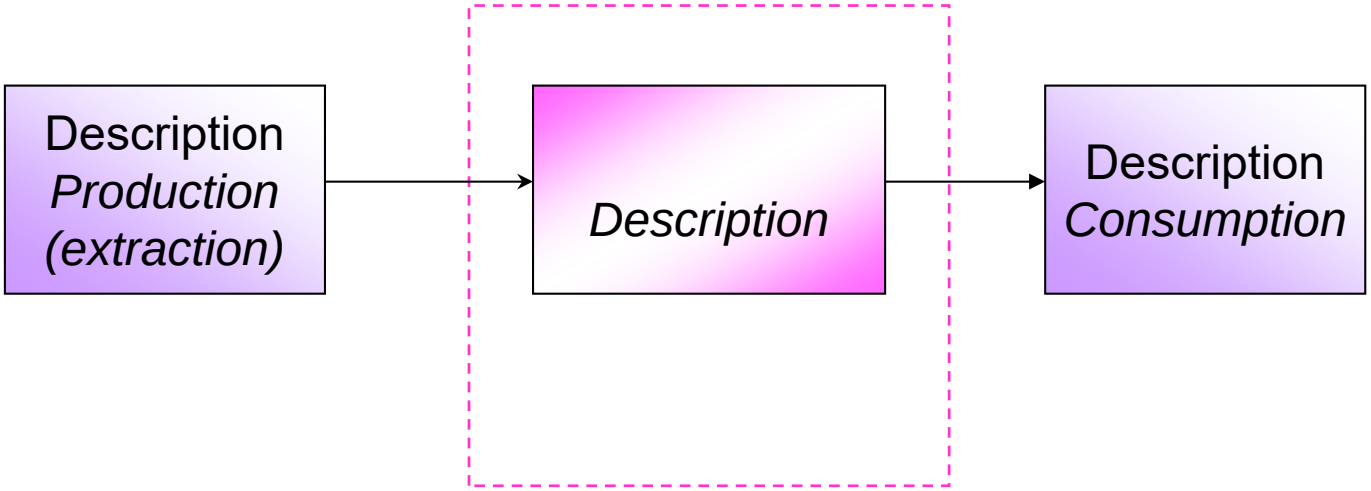
Metadata - Schemas

- General:
  - Dublin Core
  - **METS** (Metadata Encoding and Transmission Standard)
    - Rather a container (as MPEG-21)
    - XML. Wraps other standards
  - **XMP** (eXtensible Metadata Platform)
    - Adobe → ISO
- Libraries:
  - **MARC** (Machine-Readable Cataloguing)
  - **FRBR** (Functional Requirements for Bibliographic Records)
  - **RDA** (Resource Description and Access)

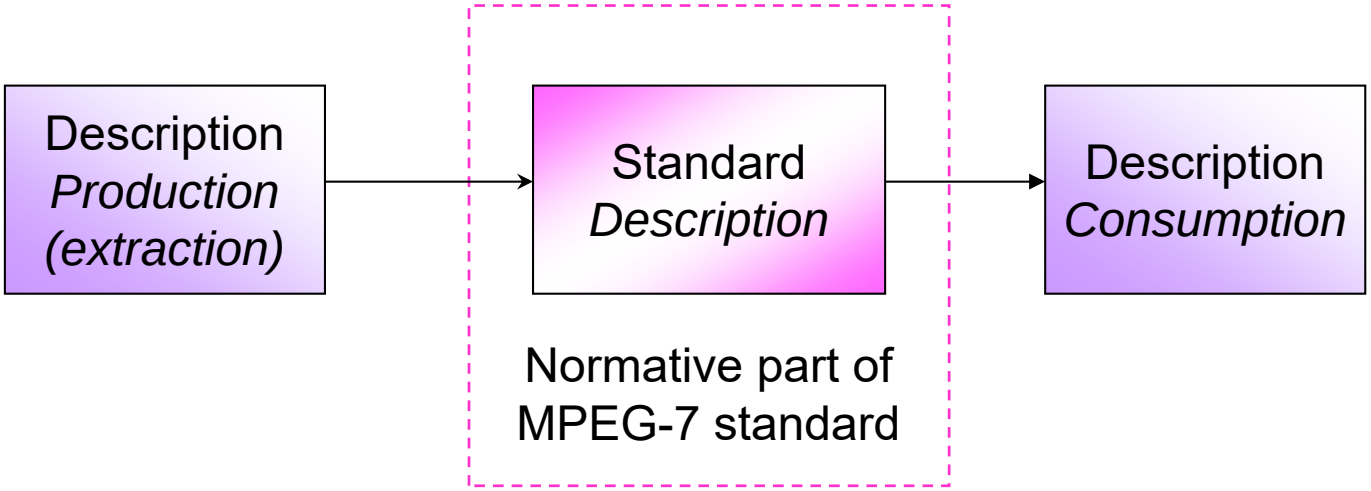
Metadata - Schemas

- Images:
  - **Exif** (Exchangeable image file format)
    - Photo cameras.
    - In JPEG, TIFF, …
  - **JPSearch**
  - **JPOnto** (JPEG)
    - New work on LinkedData and Ontology
  - **VRA** (Virtual Resources Association) **Core**
    - Cultural or art images
- Audiovisual:
  - **MPEG-7** (Multimedia Content Description Interface)
  - **ID3** (Metadata container. Normally for MP3 audio)

MPEG-7 Description: Scope



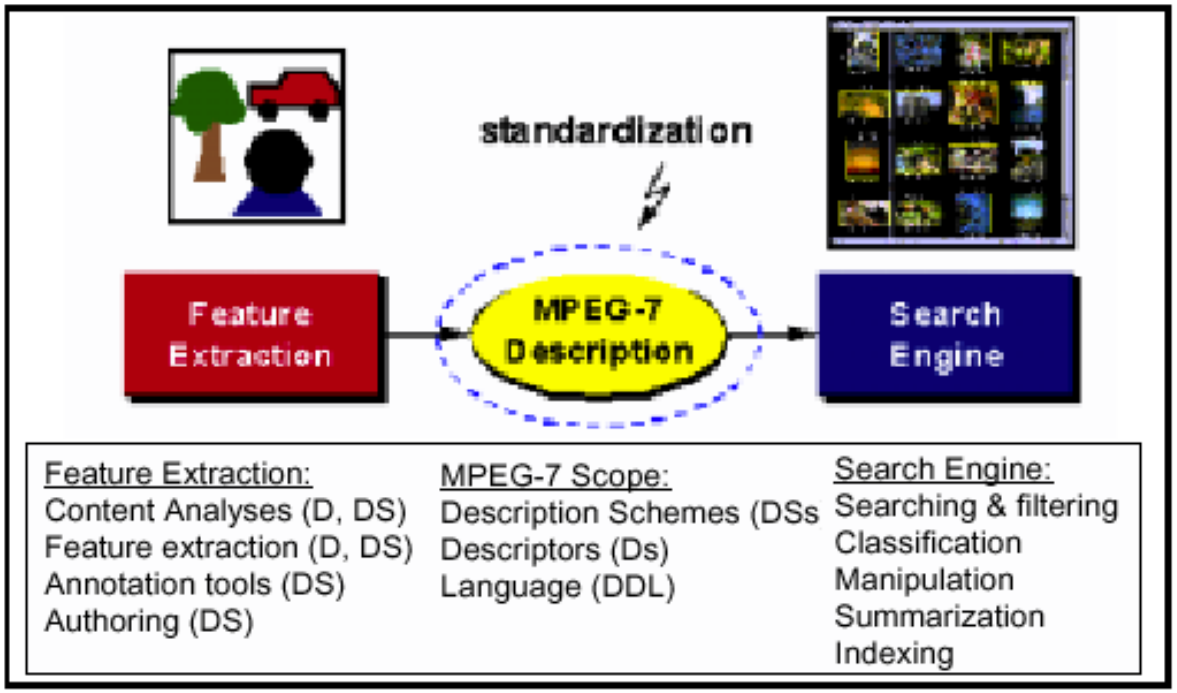
MPEG-7 Description: Scope



ISO/IEC 15938
MPEG-7:
Multimedia Content Description Interface

MPEG-7 kinds of descriptions

- Information about the content
  - Title, author, recording date, copyright, coding format, ...
- Information extracted from the content
  - Combination of low and high level descriptors

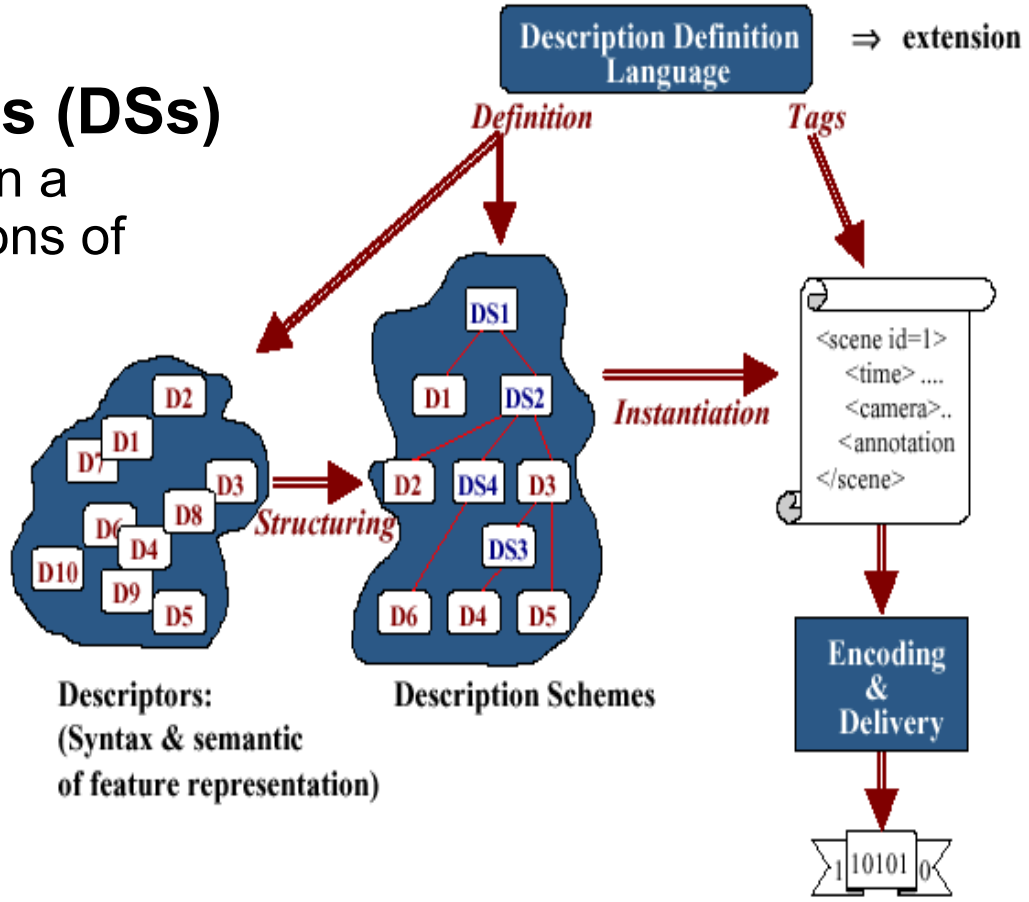


MPEG-7 parts

- Part 1: Systems
- Part 2: Description definition language
- Part 3: Visual
- Part 4: Audio
- Part 5: Multimedia description schemes
- Part 6: Reference software
- Part 7: Conformance testing
- Part 8: Extraction and use of MPEG-7 descriptions
- Part 9: Profiles
- Part 10: Schema definition
- Part 11: Profile schemas
- Part 12: Query format
- Part 13: Compact Descriptors for Visual Search

Elements of the MPEG-7 standard

- **Descriptors (Ds)**
  - Syntax and semantics of exactly one (low or high level) elementary feature
- **Description Schemes (DSs)**
  - Define structures within a framework (combinations of descriptors)
- Description Definition Language (DDL)
  - Extension of XML Schemas
- Coding Schemes
  - Create and interpret descriptions in BiM (Binary MPEG format)



MPEG-7 description example

```
<Mpeg7>
<DescritpionMetadata>...</DescriptionMetadata>
<Description xsi:type="ContentEntity">
<MultimediaContent xsi:type="VideoType">
  <Video id="video_example">
    <MediaInformation>...</MediaInformation>
    <TemporalDecomposition gap="false" overlap="false">
      <VideoSegment id="VS1">
        <MediaTime>
              <MediaTimePoint>
              T00:00:00</MediaTimePoint>
              <MediaDuration>PT2M</MediaDuration>
        </MediaTime>
        <VisualDescriptor xsi:type="GoFGoPColorType"
          aggregation="average">
              <ScalableColor numOfCoef="8"
                numOfBitplanesDicarded="0">
                <Coeff>1 2 3 4 5 6 7 8</Coeff>
              </ScalableColor>
        </VisualDescriptor>
        </VideoSegment>
        <VideoSegment id="VS2">
          <MediaTime>
              <MediaTimePoint>T00:02:00
                </MediaTimePoint>
              <MediaDuration>PT2M</MediaDuration>
        </MediaTime>
        <VisualDescriptor xsi:type="GoFGoPColorType"
            aggregation="average">
              <ScalableColor numOfCoef="8"
                numOfBitplanesDicarded="0">
                <Coeff>8 7 6 5 4 3 2 1</Coeff>
              </ScalableColor>
        </VisualDescriptor>
      </VideoSegment>
    </TemporalDecompostion>
  </Video>
</MultimediaContent>
</Description>
</Mpeg7>
```

Metadata - Schemas

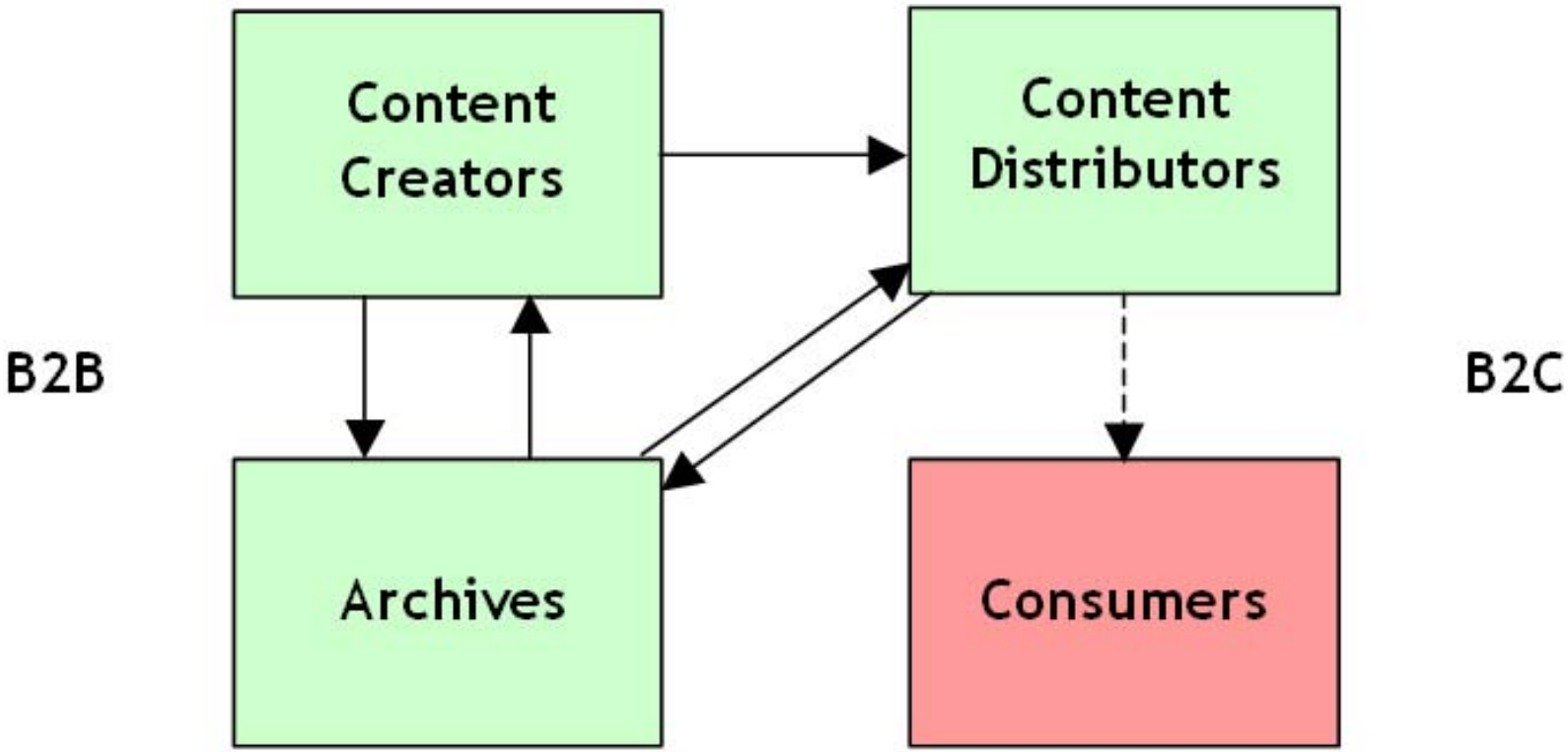
- TV:
  - **P/Meta** (EBU), **EBUCore** (EBU)
  - **PBCore** (Public Broadcasting Metadata Diccionary)
  - **SMPTE** (Society of Motion Picture Technical Experts):
    - **Data Diccionary**
    - **MXF** (Material Exchange Format)
      DMS-1 (Descriptive MD Schema)
    - **BXF** (Broadcast Exchange Format). Protocol.
  - **TV-Anytime**

- Archives:
  - **ISAD(G)** (General International Standard Archival Description)
  - **OAI-PMH** (Open Archives Initiative - Protocol for Metadata Harvesting)

Metadata - EBUCore

- Minimum information needed to describe radio and television content.
- "If you can't find it, you don't have it!".
- Creation, management and preservation of material.
- Facilitates programme exchanges between broadcasters or between content producers.

Metadata - EBUCore



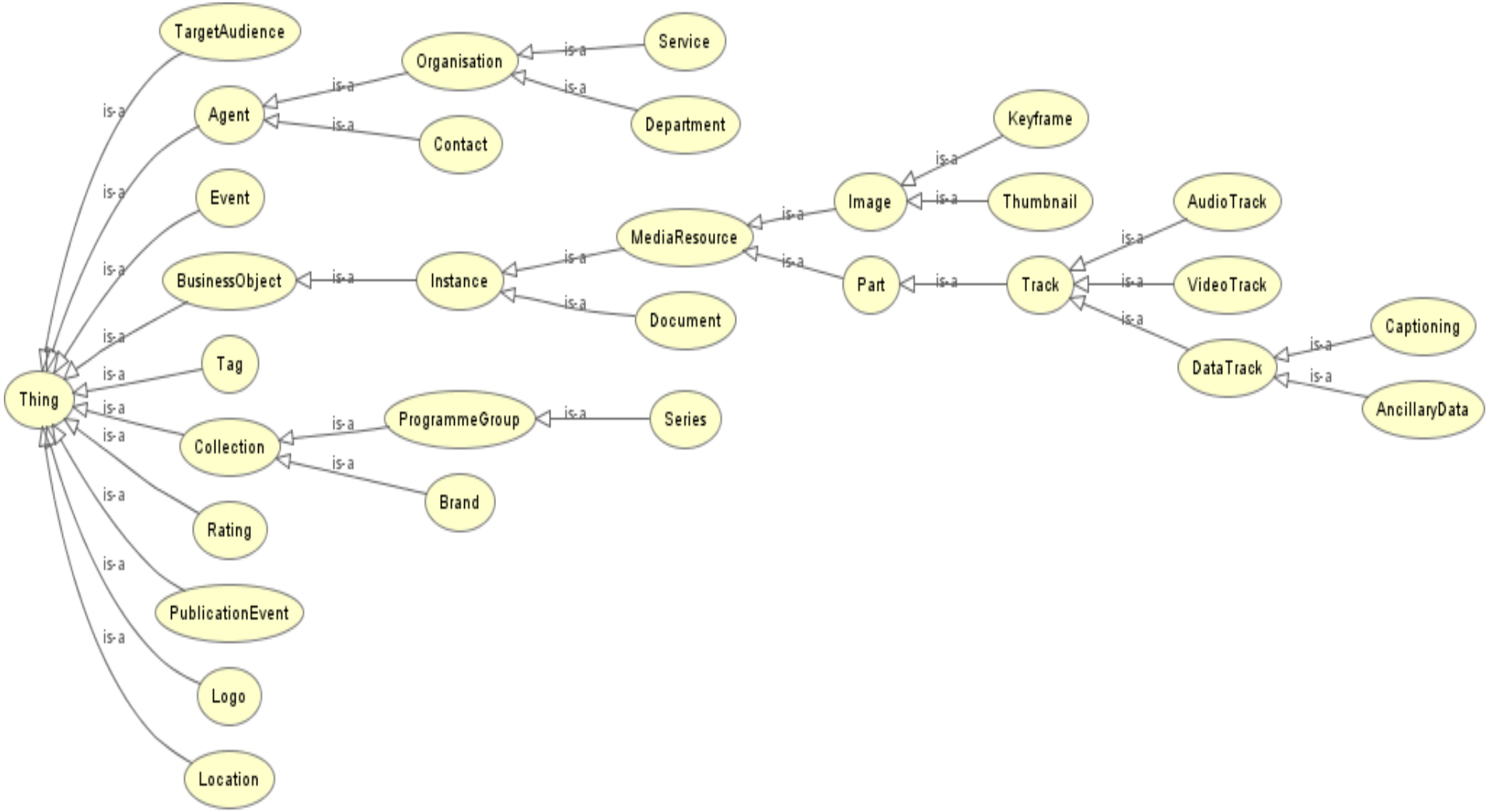
Metadata - EBUCore

- ***Core Metadata Set Elements (1/2):***
  - Title, Alternative title
  - Creator
  - Subject (topic)
  - Description
  - Publisher
  - Contributor
  - Date (created, issued, modified, digitized, …)
  - Type (genre, target audience, “objectType”)
  - …

Metadata - EBUCore

- ***Core Metadata Set Elements (2/2):***
  - Format (technical characteristics):
    Image, Video, Video track, Audio, Audio track, Data, Captioning, Ancilliary data, Signing, Start, End, Duration, Document, Technical attributes, etc.
  - Coverage (time and place aspects)
  - Rights
  - Version
  - Publication history
  - Rating
  - Part
  - Metadata provider
  - Entity

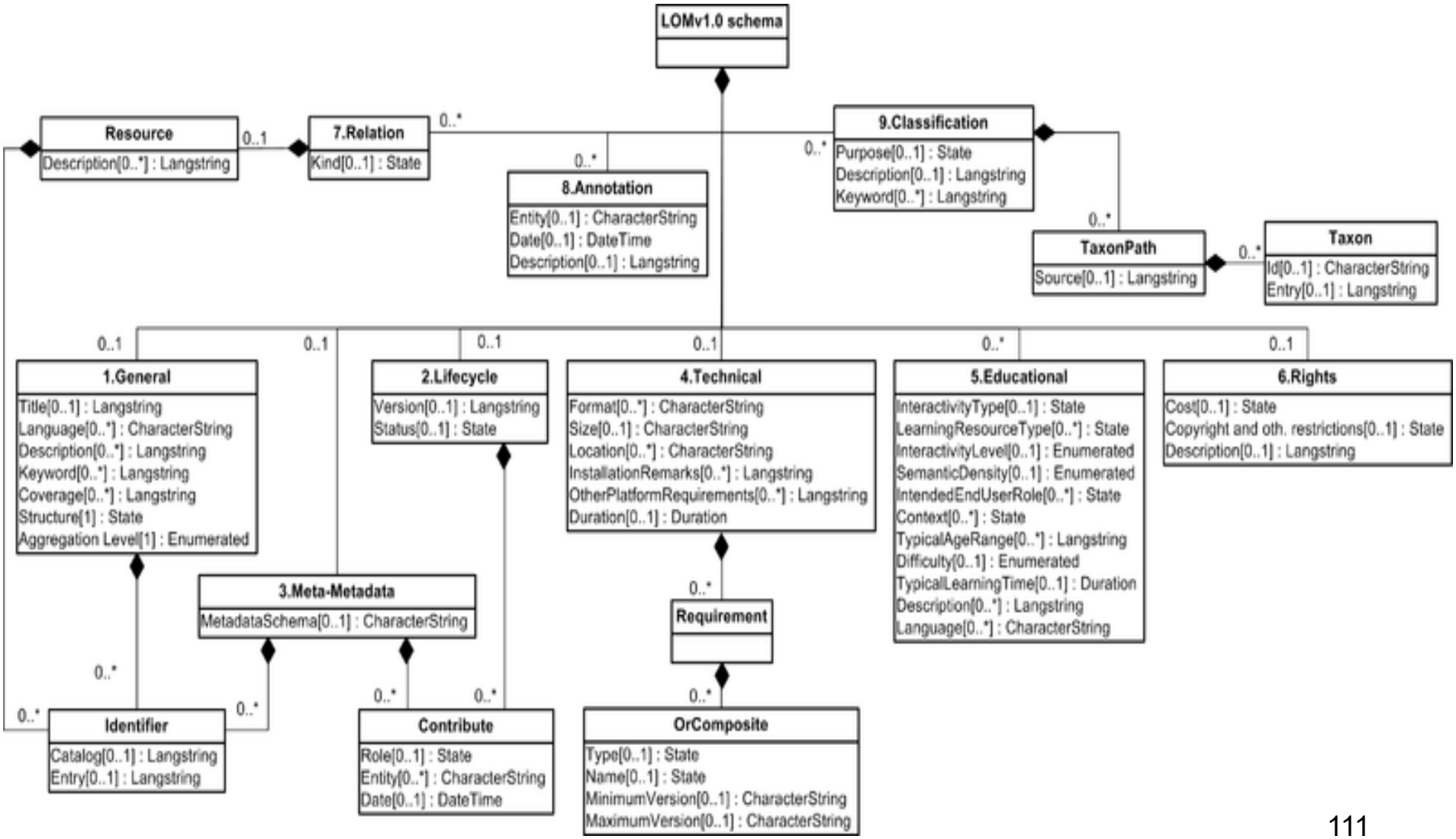
EBUCore – Conceptual Data Model



Metadata - Schemas

- Education:
  - **IEEE LOM** (Learning Object Metadata)
- Preservation:
  - **PREMIS OAIS** (Open Archival Information System)
    - Base for a new MPEG standard
  - **CIDOC CRM** (Conceptual Reference Model)
    - Museums, Cultural heritage
- Others:
  - **IPTC** (International Press Telecommunication Council)
  - **TEI** (Text Encoding Initiative)
    - Literature texts

Metadata – IEEE LOM



Multimedia content

2018/19 Q1

Silvia Llorente

Jaime Delgado *

DAC – UPC

* Part of the material comes from other sources.