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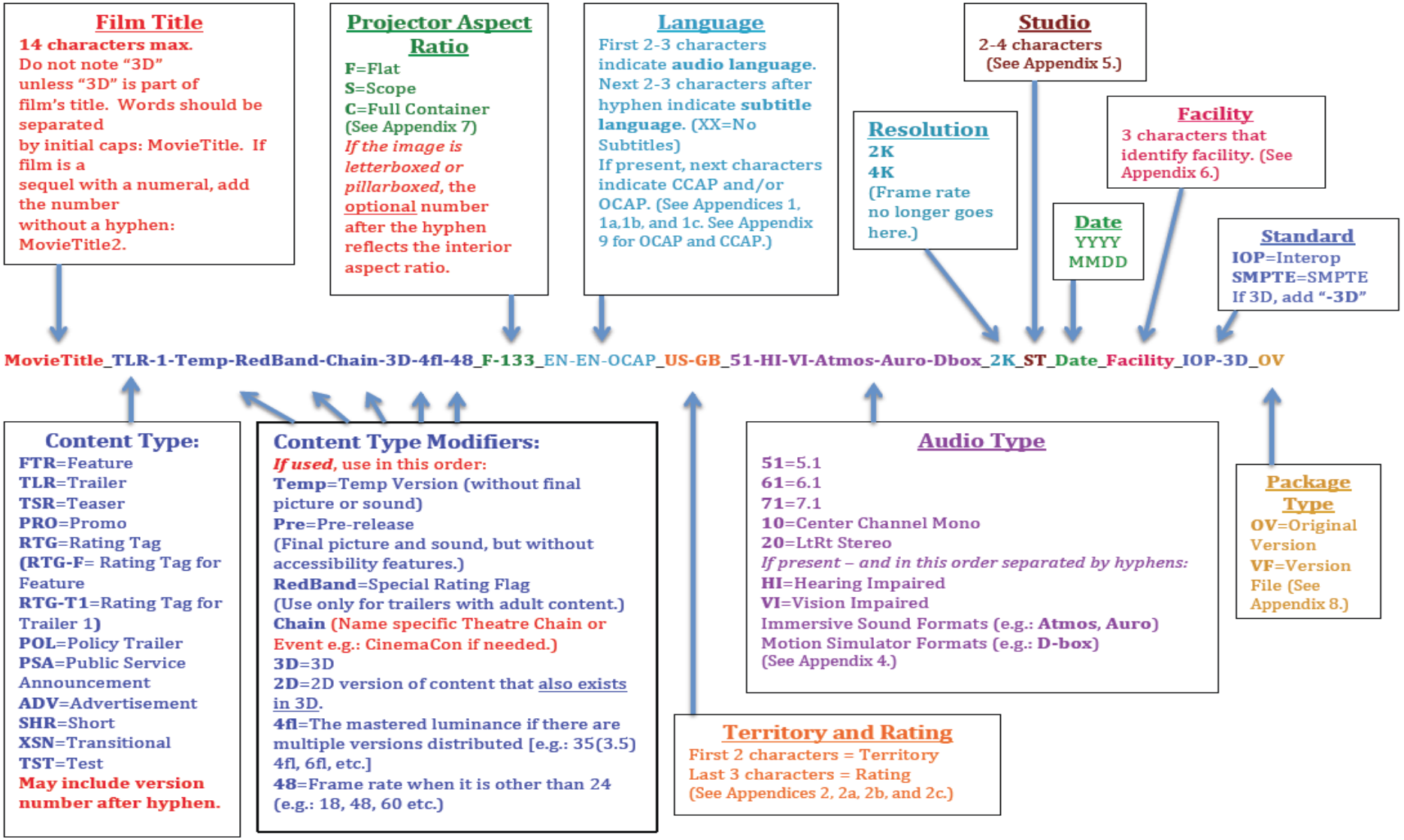
DCI manufacturing processes and digital cinema distribution

The DCI production workflow and digital content management


Film Title
14 characters max.
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S=Scope
C=Full Container
(See Appendix 7)
If the image is letterboxed or pillarboxed, the optional number after the hyphen reflects the interior aspect ratio.
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First 2-3 characters indicate audio language. Next 2-3 characters after hyphen indicate subtitle language. (XX=No Subtitles)
If present, next characters indicate CCAP and/or OCAP. (See Appendices 1, 1a,1b, and 1c. See Appendix 9 for OCAP and CCAP.)
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2-4 characters
(See Appendix 5.)
Resolution
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4K
(Frame rate no longer goes here.)
Facility
3 characters that identify facility. (See Appendix 6.)
Date
YYYY
MMDD
Standard
IOP=Interop
SMPTE=SMPTE
If 3D, add "-3D"
MovieTitle_TLR-1-Temp-RedBand-Chain-3D-4fl-48_F-133_EN-EN-OCAP_US-GB_51-HI-VI-Atmos-Auro-Dbox_2K_ST_Date_Facility_IOP-3D_OV
Content Type:
FTR=Feature
TLR=Trailer
TSR=Teaser
PRO=Promo
RTG=Rating Tag
(RTG-F= Rating Tag for Feature
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(Final picture and sound, but without accessibility features.)
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4fl=The mastered luminance if there are multiple versions distributed [e.g.: 35(3.5) 4fl, 6fl, etc.]
48=Frame rate when it is other than 24 (e.g.: 18, 48, 60 etc.)
Territory and Rating
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(See Appendices 2, 2a, 2b, and 2c.)
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61=6.1
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20=LtRt Stereo
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VI=Vision Impaired
Immersive Sound Formats (e.g.: Atmos, Auro)
Motion Simulator Formats (e.g.: D-box)
(See Appendix 4.)
Package Type
OV=Original Version
VF=Version File (See Appendix 8.)

DCI Specifications

- Digital Cinema Initiatives, DCI was created in March, 2002, and is a joint venture of Disney, Fox, Paramount, Sony Pictures Entertainment, Universal and Warner Bros. Studios.

  The latest version March 07, 2008

- DCI's primary purpose is to establish and document voluntary specifications for an open architecture for digital cinema that ensures a uniform and high level of technical performance, reliability and quality control.

- The DCI specification does not include specific information about how data within a distribution package has to be formatted. Formatting of this information is defined by the Society of Motion Picture and Television Engineers (SMPTE) in the digital cinema standards.

Image ratios overview

2D images :

2048x1080 (2K) at 24, 25, 30 frames/sec

and with HFR (High Frame Rate) 48 and 60 frames/sec

or 4096x2160 (4K) at 24, 25, 30 frames/sec

- In 2K, Scope (2.39:1) = 2048x858 pixels
- In 2K, Flat (1.85:1) = 1998x1080 pixels
- In 4K, Scope (2.39:1) = 4096x1716 pixels
- In 4K, Flat (1.85:1) = 3996x2160 pixels

Stereo 3D images : (no 4K)

2048x1080 (2K) at 24 or 48 frames/sec per eye in HFR

- In 2K, Scope (2.39:1) = 2048x858 pixels
- In 2K, Flat (1.85:1) = 1998x1080 pixels

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Image and Audio format

- Images are compressed with JPEG2000 format in a XYZ specific color space (CIE 1931) one file per frame, with 12 bits per color component
  (4096 colors per component)

- DCP compression rate 250 Megabits/sec

- Audio is mono 24 bits per channel, 48 kHz or 96 kHz, up to 16 channels (but 5.1 or 7.1 are the most used), in WAV container and uncompressed PCM @ 24 frame/s.

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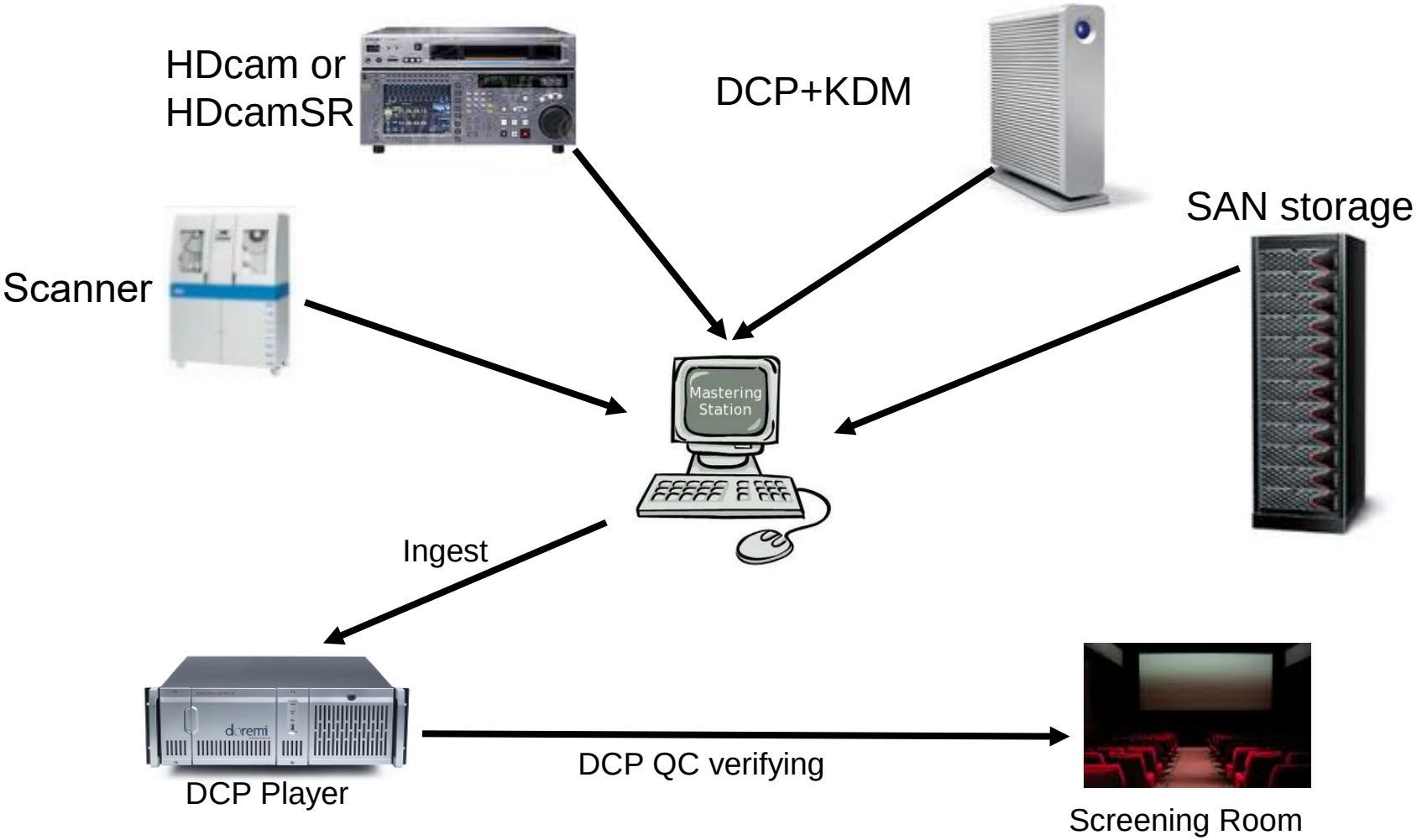
Input Elements



The DCI Mastering Steps

- The generation of a Digital Cinema Package (DCP) consists of various steps and phases

Digital Source Master

Any source of digitized images .dpx or .cin in RGB format with any pixel ratio, frame rate and bit depth...

Lossy Compression Stage

For saving storage space and bandwidth, the size of a DCP must be reduced so that it can be transported, saved and displayed without great efforts. So the image files of the DCP will be converted to 12 bit (X'Y'Z') and then encoded with JPEG2000. The audio data will not be compressed.

Digital Cinema Package

The last stage of a DCP creation, audio and J2C encoded image files will be wrapped (either encrypted or not) in the MXF format as the DCP's content delivery format.

Digital Cinema Distribution Master

It's a standardized format to exchange movies between the studio and the post-production. This DCDM is uncompressed (i.e. in 16-bit X'Y'Z' , TIFF file format) and contains all the specifications of the future DCP (resolution, frame rate and audio channels). As a high end master the DCDM is used for long term archiving f.ex. on LTO tapes…Waiting for next generation archive format IMF…

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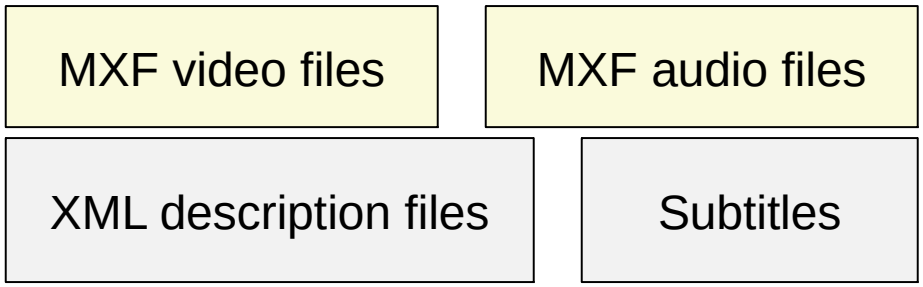
The DCP Structure

- Finally the DCP (Digital Cinema Package) is a set of files where soundtrack and videotrack are separated but wrapped in MXF files and linked with the set of XML descriptor files (CPL=Composition Playlist, digital signature for each file of the package) and subtitles.

- MXF files of a DCP can be encrypted. In this case the package author must provide a key delivery message (KDM) to allow a DCP server to play the feature during a given period.

Digital Cinema Package



Work with partial DCP

- The encoding of a partial DCP is the most often used method. It allows to associate a full feature DCP with a second package containing only additional content, like new subtitles file for example. In this case, the media elements of the first package (master DCP) are simply linked and not copied into the second (partial DCP), but both are required to play the second version. If the DCP (images and sounds) is about 1 GB (1Byte=8bits!) per minute, a subtitle file takes only a few KB. So, for a few extra KB you have the whole film with new subtitles.

- The distribution media of the DCP (usually an external hard drive) must contain the master package in addition to partial versions. The cinema must ingest all packages but will be able to play only the one corresponding to the KDM he's recieved.

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KDM management

- Because of the encryption of DCPs and digital signatures contained in the package description files, the laboratory that manufactured the package is the only one who is allowed to provide a key to unlock (decrypt) screening for a given server.

- The KDM (Key Delivery Message) is a small XML file made from the certificate of the player and the Composition Playlist (CPL) of the package. Without this file or if the current date does not correspond to the period of validity of the KDM, no screening is possible.
- For this, the laboratory must have the certificate of authentification of this server. The number of digital devices is constantly increasing. It is necessary to have a database of security certificates to provide KDMs.
- If you want to order KDMs from an encrypted DCP in a third party facility, the lab has to deliver the master key, called DKDM.

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DCP distribution

To transport the DCP to the screening rooms, there are **2 options**:

- **First** : send a hard-drive containing the DCP to the theater for ingest.
- **Second** : if the theater is equipped and connected, send the package via specifics networks like SmartJog, GlobeCast or CineGo.

This second solution is probably the future of dematerialized digital distribution. More and more also through ADSL and F

Automation on the exhibitor side : the TMS (Theater Management System) which provides such functions as: secure central storage of ingested packages (one ingest for multiple servers), the ability to automate the launch of the sessions, remote control of all the digital projection equipment in a cabin and manages the decryption keys (automatic checks and dispatch received KDM).

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Distribution trends

- DCP in multi CPL (all versions in one package)
- Ingest of this DCP (multi CPL) simultaneously in all existing servers or TMS of a region without any preselecting and the KDM will do the programming
- No version error possible (because only one package)
- No ingest error possible
- But heavy responsibility of the distributor to manage the right KDMs for multi CPL
- DCP with multi PKL (different packaging in same DCP)
- Move from Interop to SMPTE for HDR, Eclaircolor, Dolby Vision HFR etc

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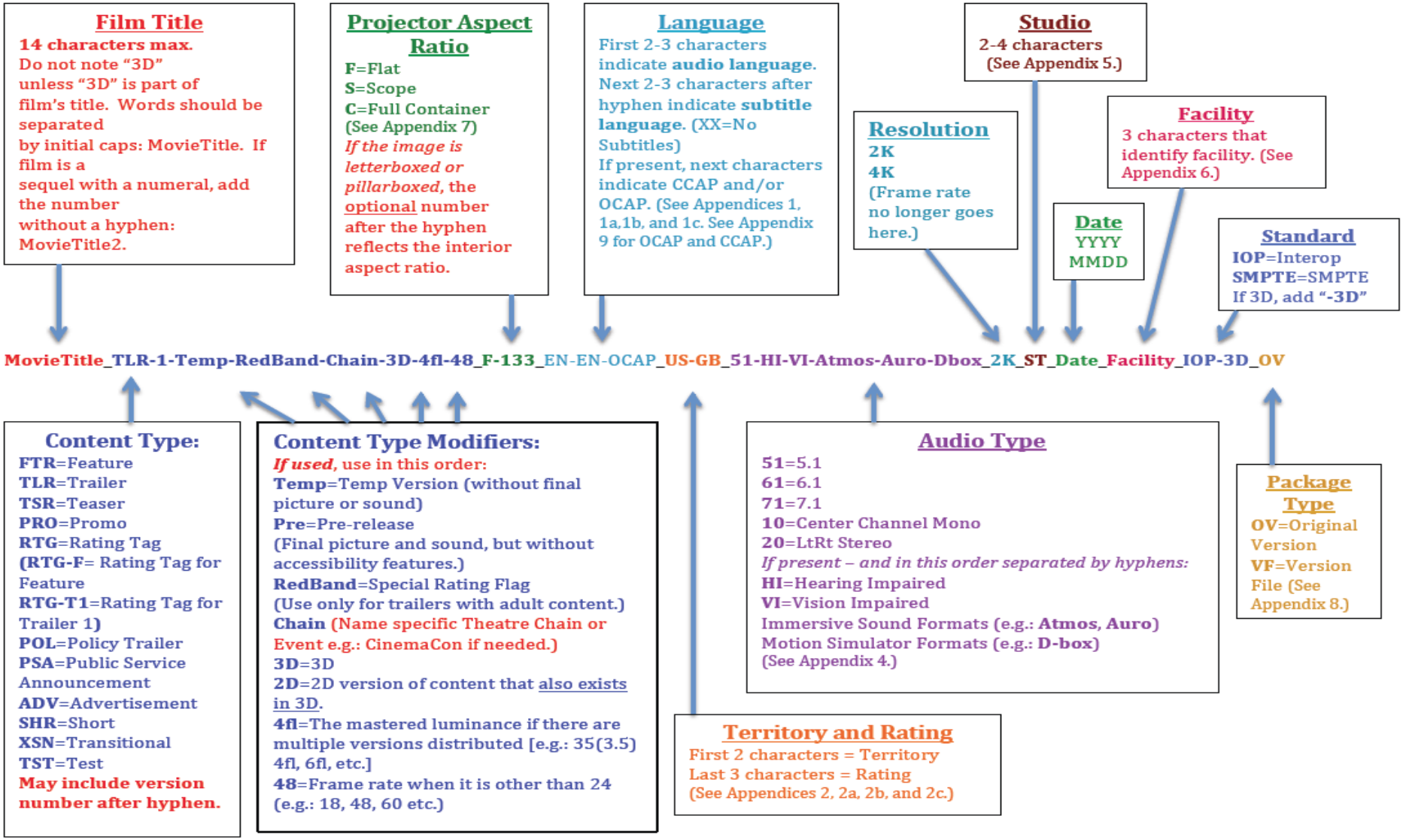
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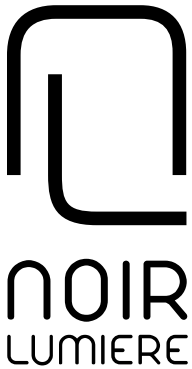
Presentation Digital Platforms
for Distribution

www.cinego.net

for film making & catalogue managing



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