IMF at Netflix

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NETFLIX

February 23, 2017

The Netflix Content Processing System

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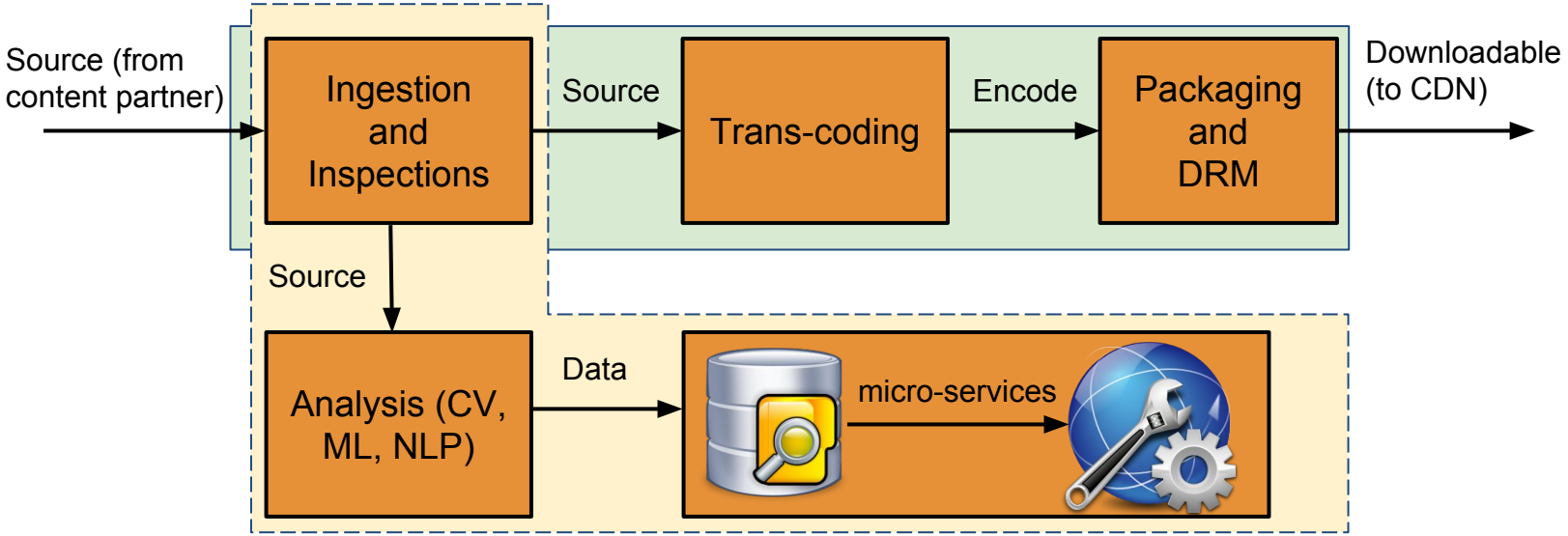

- Cloud Media Systems team develops cloud-scalable systems and tools
  - Systems layer for audio, timed text and video
    - e.g., IMF, QuickTime, W3C TTML and MP4-DASH
  - Deep source analysis, data persistence and serving

Acknowledgements

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- Andy Schuler (aschuler@netflix.com)
- Sreeram Chakrovorthy (schakrovorthy@netflix.com)
- Subrahmanya Venkatrav (svenkatrav@netflix.com)
- John Hurst, Cinecert
- Dr. Pierre Lemieux, Sandflow

Talk Outline

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- Why IMF?
- The Netflix IMF Workflow
- Case Study
- Community Work and Roadmap

Talk Outline

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- **Why IMF?**
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Worldwide Netflix Footprint

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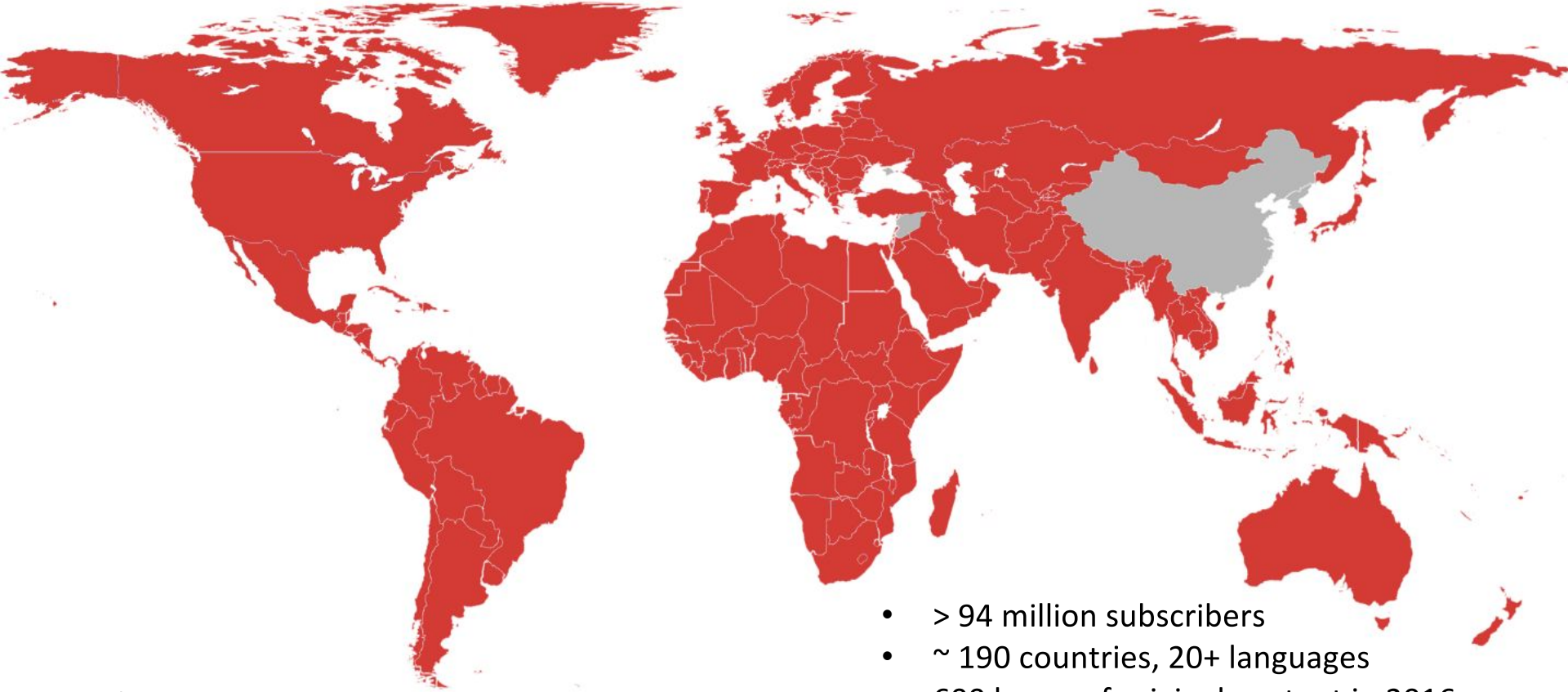

- > 94 million subscribers
- ~ 190 countries, 20+ languages
- 600 hours of original content in 2016

IMF in the Digital Supply Chain

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IMF provides several operational benefits to Netflix and the Digital Supply Chain ecosystem

- "**Prescription for Versionitis**": scalable solution for versioned asset management and archival of premium digital content created for global consumption
- **Modular (componentized) Deliveries**: interchange of high quality digital masters with minimal operational overhead (through the notions of a partial IMF Master Package)
- **Business Integration**: Defines optional constructs for tighter integration of business logic and deliveries

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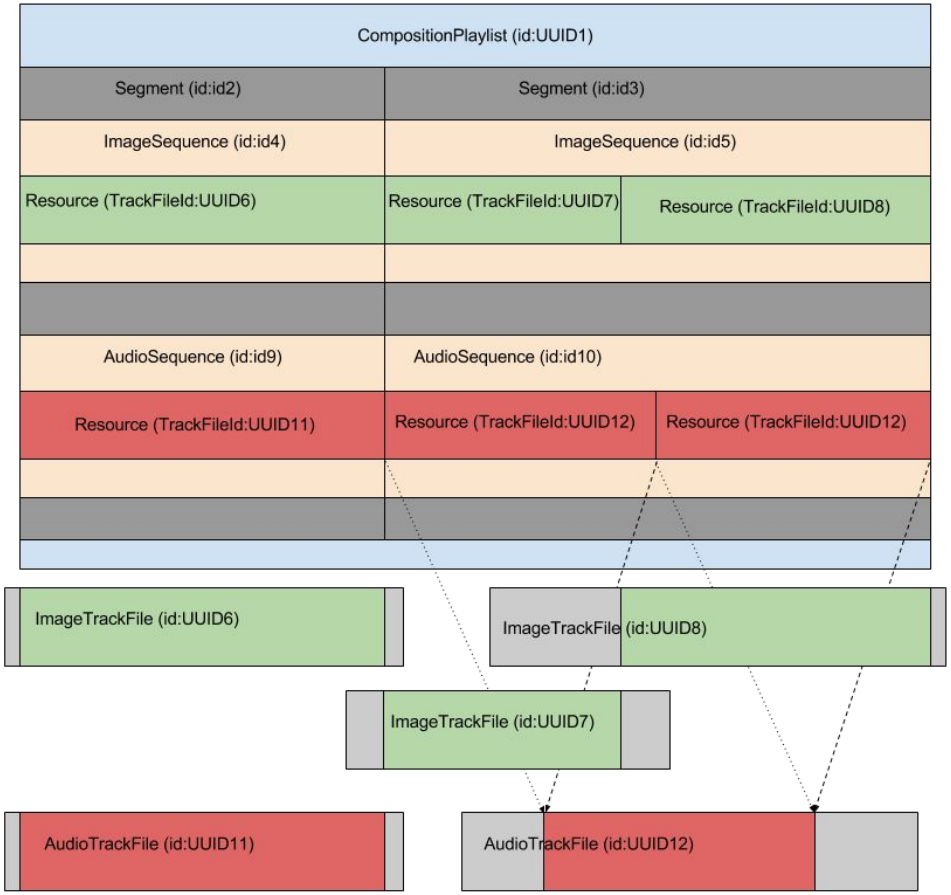
The Composition Playlist (CPL)



- CPL refers to external track files that contain the actual essence
- Multiple compositions that share essence can be managed without duplicating essence
- Essence referencing mechanism decouples asset delivery and playback timeline concepts

IMP Delivery Illustration

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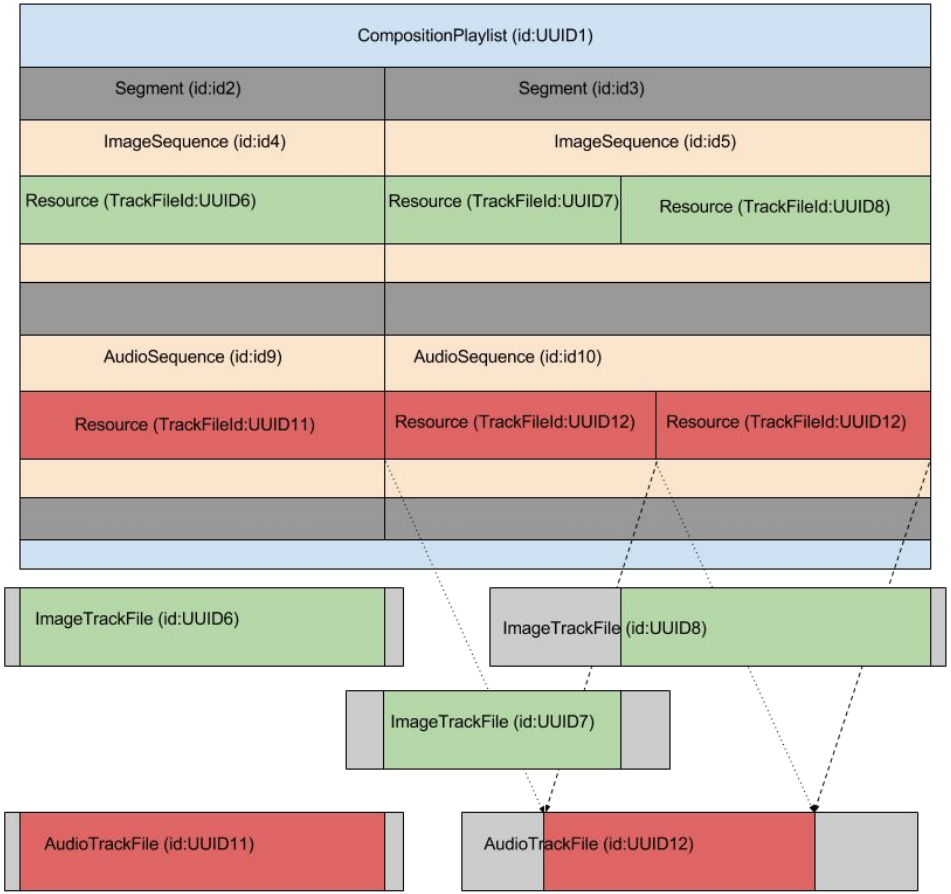
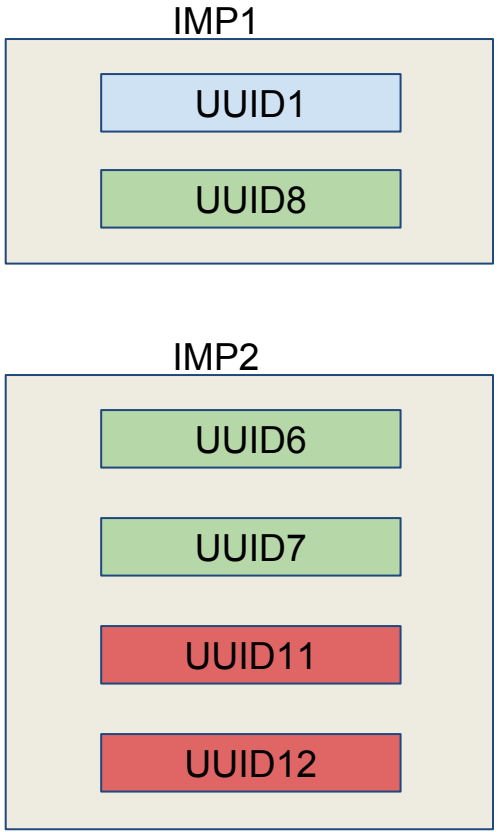
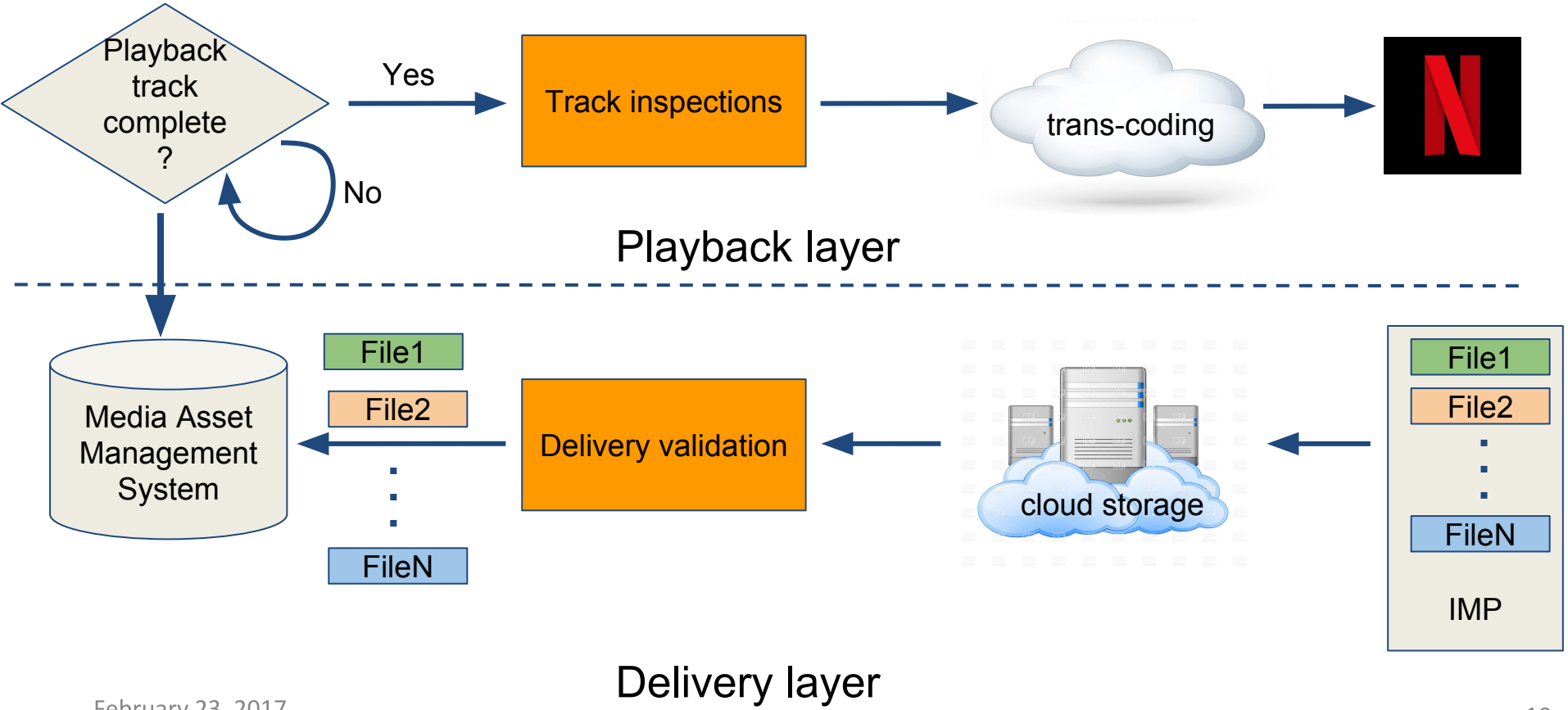




The Netflix IMF Workflow



Delivery API (Request)

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POST https://backlot-api.netflix.net/v1/deliveries


```
[{
   "requestId": "1234",
   "tracks": [{
      "id": "5ccb3012-da83-4d3d-86e7-b349731cbf9d", "type": "MainImageSequence",
      "compositionPlaylist": { "id": "8361bc65-98ec-4fd3-bb9d-305c8fe40945", "originalFilename": "CPL-8361bc65-98ec-4fd3-bb9d-305c8fe40945.xml", "size": 10347},
      "packingList": {"id": "f989a33a-bc5e-4f0b-9f76-2d539c10c643", "originalFilename": "PKL-f989a33a-bc5e-4f0b-9f76-2d539c10c643.xml", "size": 1626},
      "assetMap": { "id": "5b3327b8-c8ff-4fad-b286-ae9631f342a9", "originalFilename": "ASSETMAP.xml", "size": 250},
      "essences": [{
         "id": "f961bddb-be04-4998-b3c4-c3744c5df8ad", "originalFilename": "Meridian.mxf", "size": 94242886756}]},
     {
      "id": "dd875c2c-4e21-4e42-b16c-ab6e29b34f60", "type": "MainAudioSequence",
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      "assetMap": {"id": "5b3327b8-c8ff-4fad-b286-ae9631f342a9", "originalFilename": "ASSETMAP.xml", "size": 250},
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}]
```

Delivery API (Response)

NETFLIX


```
{
   "User": "netflixUser",
   "Host": "netflixHost",
   "deliveries": [
      { "requestId": "1234", "fileName": "ASSETMAP.xml",  "fileTransportToken": "d1434d4c-efc9-11e6-bc64-92361f002671" },
      { "requestId": "1234",  "fileName": "PKL-f989a33a-bc5e-4f0b-9f76-2d539c10c643.xml",  "fileTransportToken": "ff4ffc30-efc9-11e6-bc64-92361f002671" },
      {"requestId": "1234", "fileName": "CPL-8361bc65-98ec-4fd3-bb9d-305c8fe40945.xml", "fileTransportToken": "04557c32-efca-11e6-bc64-92361f002671"},
      { "requestId": "1234",  "fileName": "Meridian.mxf",  "fileTransportToken": "099d5cd2-efca-11e6-bc64-92361f002671" },
      {"requestId": "1234", "fileName": "Meridian_2ch.mxf",  "fileTransportToken": "0dd11faa-efca-11e6-bc64-92361f002671" }
]
}
```


Upload tokens are used to transfer associated files

Merging CPLs for Same Composition

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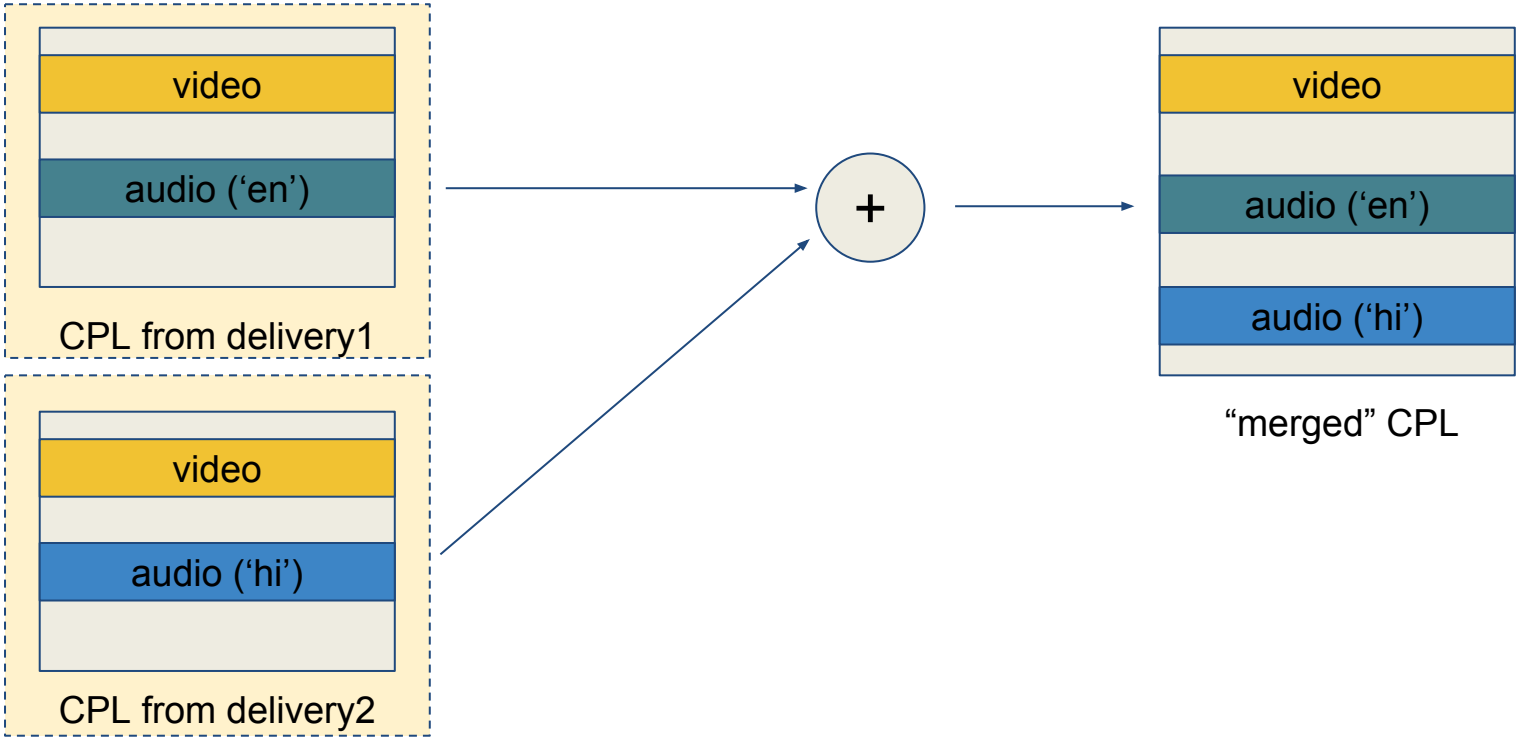

- Merge operation is akin to a delta commit in a version control system

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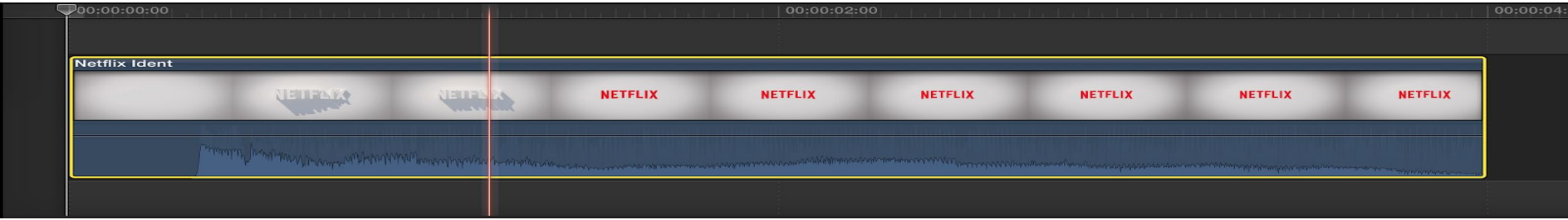
Idents at Scale: Problem Statement



- Main program of a Netflix original is preceded and succeeded by a Netflix ident (logo)
- Netflix ident is conformed A/V asset (perhaps it will have subtitles one day)
- Need ability to insert/replace idents at will across the entire originals catalog

Idents at Scale: Solution

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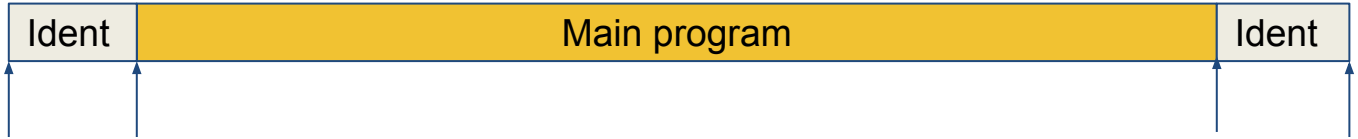

- IMF CPL markers delineate beginning and end idents in playback timeline of OV
- Trans-coding workflow produces ident-free proxy to seed ident-free dub/sub localization
- On demand, “update” idents by creating a new playback track
- Playback tracks from localization deliveries are ident-augmented like OV

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Open Source Activity

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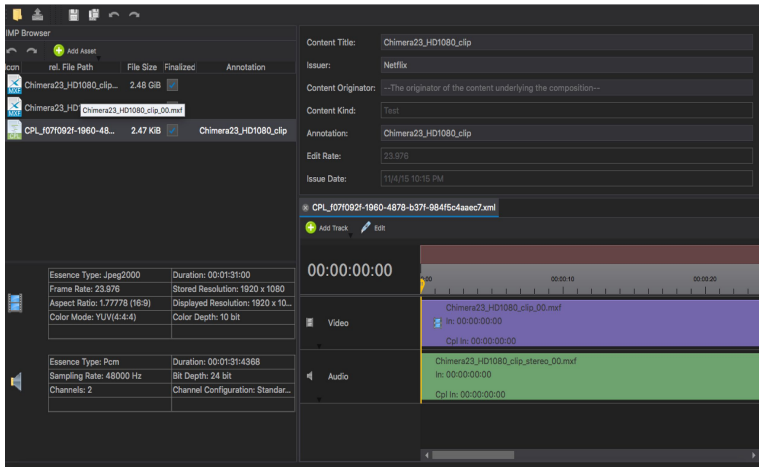
- Photon (https://github.com/Netflix/photon) (December 2015)
  - developed at Netflix
  - complete set of tools for validation of IMF packages
- regxmllib (https://github.com/sandflow/regxmllib)
  - sponsored by Netflix
  - tools that provide essential building blocks for authoring of IMF CPL
- ttt (https://github.com/skynav/ttt)
  - sponsored by Netflix
  - tools for validation and rendering of Timed Text Markup Language (TTML 1/2)

Open Source Activity

NETFLIX

- IMF Transformer
  - https://github.com/DSRCorporation/imf-conversion
  - sponsored by Netflix
  - tools that provide conversion from IMF to DPP (Digital Production Partnership) or iTunes format

- IMF CPL Editor
  - https://github.com/IMFTool/IMFTool
  - sponsored by Netflix
  - tools that enable lightweight CPL “editing”



Netflix Roadmap

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- Ingest Implementation
  - Timed text support
  - Metadata tracks for HDR video
  - Immersive audio

- Deliveries to Netflix
  - Targeting all IMF for delivery of originals (HD, UHD, 4K)

Challenges and Future Work

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- Legacy assets and production workflows abound
- Version management between one publisher and consumers is easy. What happens when multiple parties (e.g., content providers and service providers) get together to produce a composition?
- IMF Composition and video track are closely coupled concepts today
- Integration with business systems (e.g., EIDR)

Talk Summary

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- Scale of Netflix business necessitates using IMF
- Netflix plans to be 100% IMF
- Netflix is actively involved in OSS efforts around IMF as well as timed text

Questions?

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THE END