北京
2019

遨游“视”界 做你所想
Explore World, Do What You Want

LiveVideoStackCon 2019 北京

Next Generation Codecs in the Real World: Multi-Codec Per-Title 3-Pass Video Encoding Workflow for Leading Asia-Pacific Region Broadcaster Hulu Japan

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出品: LiveVideoStack 音视频技术社区 CSDN

深圳
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Introduction

- About Bitmovin
- About Hulu Japan
- Customer Pain Points & Problems to Solve
- Solutions
  - 3-Pass
  - Per-Title Encoding
  - Multi-Codec Streaming
- Implementation & Deployment
- ROI Measurement

Stefan Lederer

Background in CS & BA
McKinsey, IBM, Dolby USA
20+ Research papers and patents

What is Bitmovin?

Huluとは
メニュー
ランキング
海外ドラマ・TV
国内ドラマ・TV
洋画
邦画
アニメ
リアルタイム
特集一覧
今すぐお試し
月額
933円
（税抜）
人気映画やテレビ番組が、今すぐ見放題
2週間無料!
国内外ドラマや映画が、PC・TV・スマホな
どいつでもどこでも視聴可能！
Huluとは
今すぐ無料でおためし
すでにHuluにご登録済みの方は、こちらからログインをお願いします。
スメ
もっと見
無料
無料あり
ウォーキング
デッド
無料あり
GOT
無料あり
クリミナル

動画を見るなら
hulu
hulu.jp
もったいない!
タブレット買ったのに
動画も見てないなんて…。
動画を見るなら hulu
通勤電車も、お気に入りのカフェも、
リビングルームも、キャンプ場も、
行きつけのバーも、
今いる場所がシアターに。
動画を見るなら hulu
ハリウッド派も、邦画派も、
アニメ派も、ドラマ派も、
満足しないワケがない。
動画を見るなら hulu
動画を見るなら
hulu
hulu.jp

Huluオリジナルストーリー「扉の向こう」（8）

エピソードナンバーが古い順

楽しみが広がる視聴方法

様々な機器で視聴が可能です。

The Challenges

- **Cost**
  - Cloud Origin Storage Costs
  - CDN Egress Costs
- **Quality**
  - Mixed Content Types, encoded in a single “Golden Ladder” varied drastically in visual quality at the highest bitrates
  - Delivering better quality video over smaller pipes
- **SVOD Market Competition**
  - Customers judge their experience, based on the best experience they have had anywhere else, including HD broadcast OTA.
- **Technology Adoption**
  - New Codecs - AV1/VVC not ready for Primetime. Room to optimise what's already available

Delivering on the Challenges...

Hulu Japan

Bitmovin technologies used:

- Per-Title
- Multi-Codec: H.264, HEVC and VP9

Result: Combine it all together for 30% CDN savings

3-Pass

Per-Title

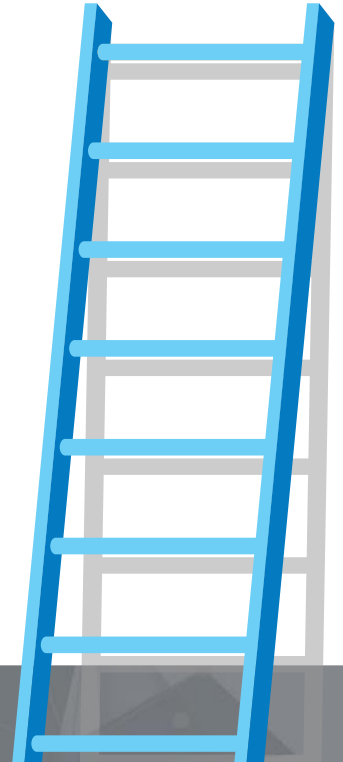
Multi-Codec

Combine it all together for 30% CDN savings

Three-Pass Encoding

Optimise Every Chunk. Simple to Implement

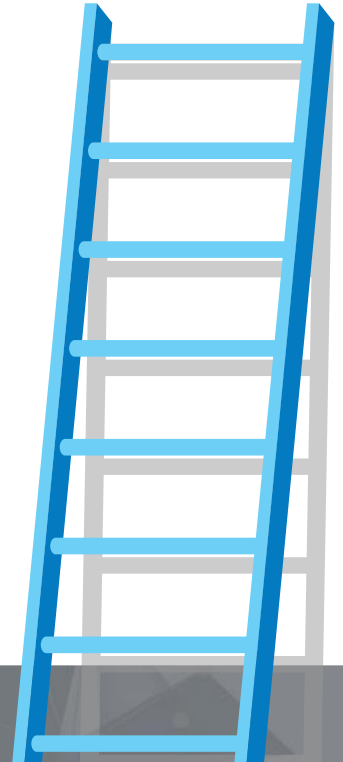
Implementation of 3-Pass (Storage Reduction)



Bitrate (kbps)	Resolution	File Size (2-Pass)	File Size (3-Pass)	Change
200	256 x 144	19.1	17.7	-7.33%
400	512 x 288	33.9	31.0	-8.55%
750	640 x 360	59.9	54.1	-9.68%
1200	853 x 480	93.2	83.3	-10.62%
1600	1024 x 576	122.1	108.9	-10.81%
2500	1280 x 720	189.7	166.3	-12.34%
3500	1280 x 720	264.3	228.9	-13.39%
4500	1920 x 1080	336.8	290.2	-13.84%
6500	1920 x 1080	447.2	382.8	-14.40%
	Total	1566.2	1363.2	-12.96%

General Purpose Bitrate Ladder - H.264 / 10 Min HD Source File

Implementation of 3-Pass (Storage Reduction)



Bitrate (kbps)	Resolution	PSNR (2-Pass)	PSNR (3-Pass)
200	256 x 144	30.61	30.56
400	512 x 288	33.80	33.68
750	640 x 360	35.63	35.47
1200	853 x 480	37.64	37.43
1600	1024 x 576	38.92	38.68
2500	1280 x 720	40.73	40.41
3500	1280 x 720	41.38	41.10
4500	1920 x 1080	44.16	43.56
6500	1920 x 1080	44.98	44.45

General Purpose Bitrate Ladder - H.264 / 10 Min HD Source File

Per-Title Encoding

Adjust bitrate ladder based on complexity

Per-Title Encoding

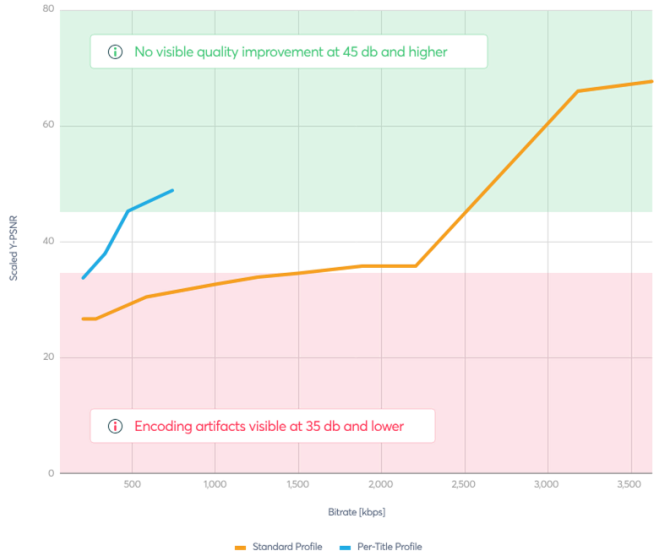
“Not too hot, not too cold, just right”

- No two pieces of content are the same, why encode them the same?
- Bitrate too **high** - wasteful (especially CDN, storage)
- Bitrate too **low** - visual artifacts, viewers less engaged, churn and market share loss

Per-Title Encoding

Per-Title Encoding allows to compute an optimized ABR ladder for a given source asset

- Optimize bitrate ladder for every single title to maximize QoE
- Compute a special purpose bitrate ladder based on complexity analysis
- Use bitrate to encode content in a quality that viewers can actually enjoy, but not more!
- Improves quality, and reduce bitrate for less complex content
- Reduce costs for files with low complexity in terms of encoding, storage and distribution



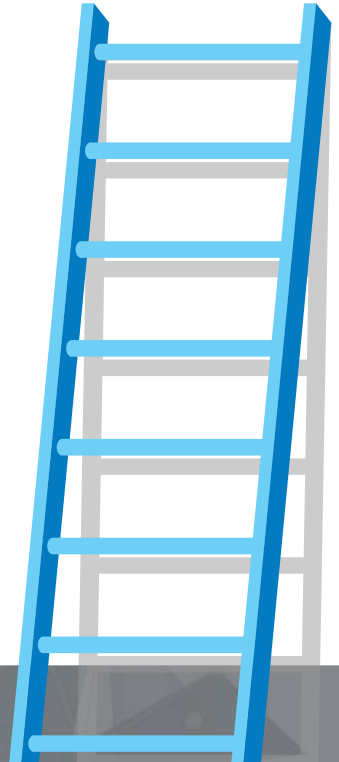
Per-Title Encoding

Benefits:

1. **Bitrate reduction - Saving money on CDN Egress**
2. **Storage reduction - Saving money on Storage**
3. **Quality improvement**

- **Consistent perceptual** quality across media library
- Encode every asset in the quality users enjoy, **but not more**
- Present high quality also to viewers in **low bandwidth scenarios** (developing countries, mobile connections, etc.)

Implementation of Per-Title



Default Ladder

Bitrate (kbps)	Resolution
200	256 x 144
400	512 x 288
750	640 x 360
1200	854 x 480
1600	1024 x 576
2500	1280 x 720
3500	1280 x 720
4500	1920 x 1080
6500	1920 x 1080
Total Size	1363.2 MB

Per-Title Ladder

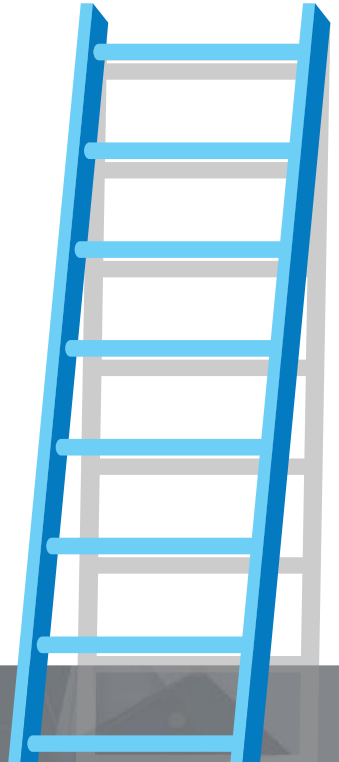
Bitrate (kbps)	Resolution
240	512 x 288
456	854 x 480
693.44	1024 x 576
1317.54	1280 x 720
2104.61	1920 x 1080
3361.86	1920 x 1080
Total Size	587.3 MB

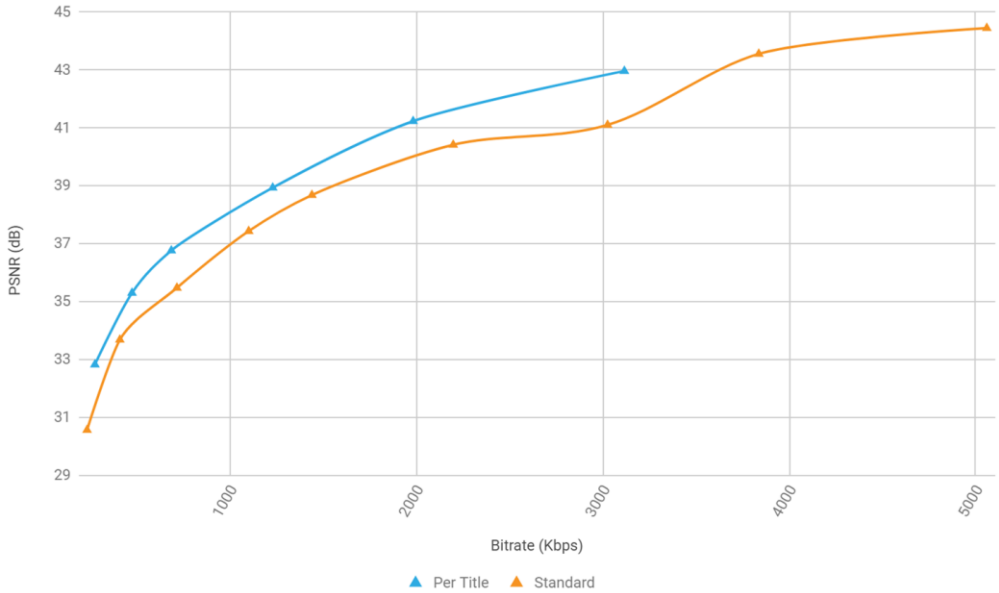
Average Bitrate
2350 Kbps -> 1362.25 Kbps **(-42%)**

Storage Consumed
1363.2 MB -> 587.3 MB **(-56.92%)**

QOE (Full HD Available)
4500 Kbps -> 2104.61 Kbps **(-53.23%)**

Implementation of Per-Title

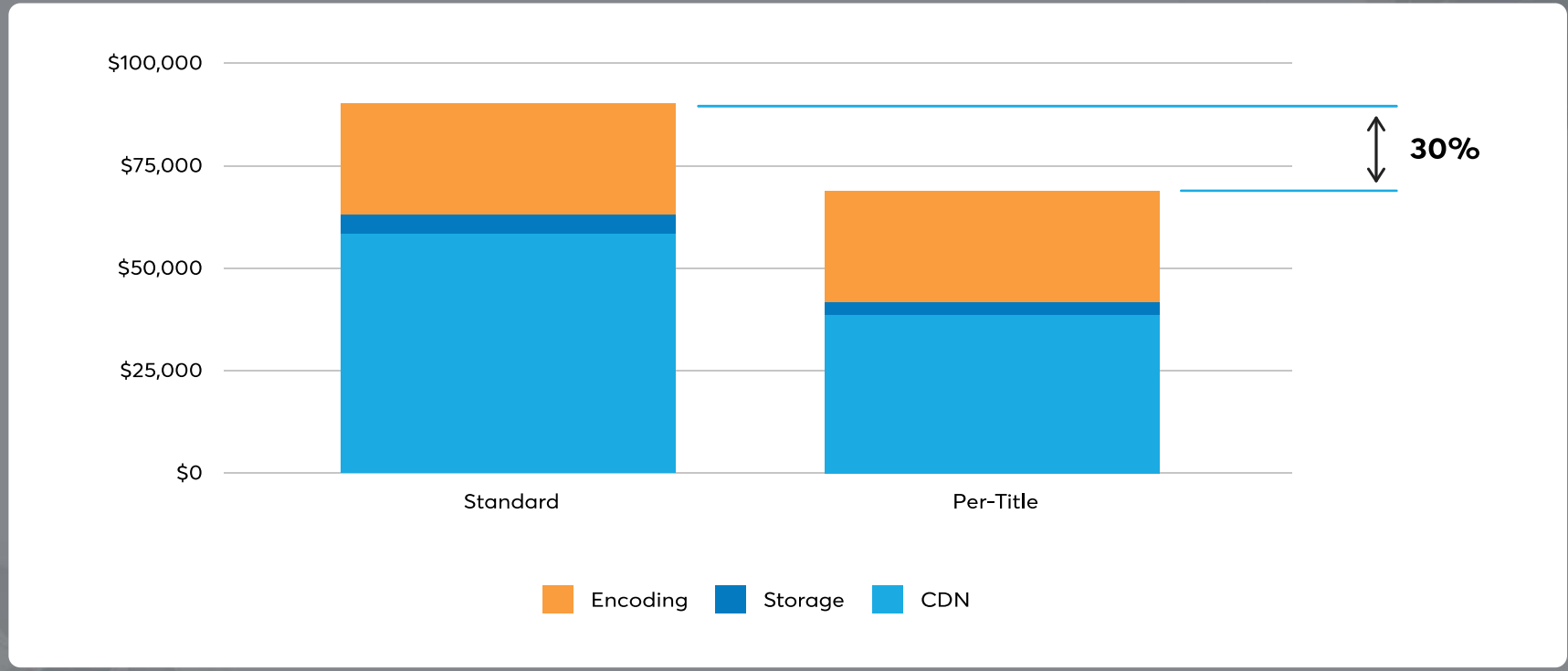




Per-Title Bitrate Ladder - H.264 / 10 Min HD Source FIle

Real World Total Cost of Operation (TCO)

Case Study - Monthly Cost (Per Title & 3 Pass)



Multi-Codec

The Right Codec for Every Device

Some Quick Maths

- iOS Holds a 20.9% Mobile Market Share in China
  96.7% of those users are running iOS 11 or later
  - > 20.2% of the China iOS Mobile Market can use HEVC
- Android Holds a 78.2% Mobile Market Share in China
  98.9% of those users are running Android 4.4 KitKat or Later
  -> 77.3% of the China Android Mobile Market can use VP9
- Therefore, **97.5%** of China’s Mobile Market can support a more efficient codec than H.264

Stats from http://gs.statcounter.com as of Aug 2019

Per-Title: Multi-Codec Ladder Comparison

Standard H.264 Ladder

Bitrate (kbps)	Resolution
200	256 x 144
400	512 x 288
750	640 x 360
1200	853 x 480
1600	1024 x 576
2500	1280 x 720
3500	1280 x 720
4500	1920 x 1080
6500	1920 x 1080
Total Size	1566.2 MB

-56.92%

Per-Title H.264 Ladder

Bitrate (kbps)	Resolution
240	512 x 288
456	854 x 480
693.44	1024 x 576
1317.54	1280 x 720
2104.61	1920 x 1080
3361.86	1920 x 1080
Total Size	587.3 MB

-34.68%

Per-Title H.265/VP9 Ladder

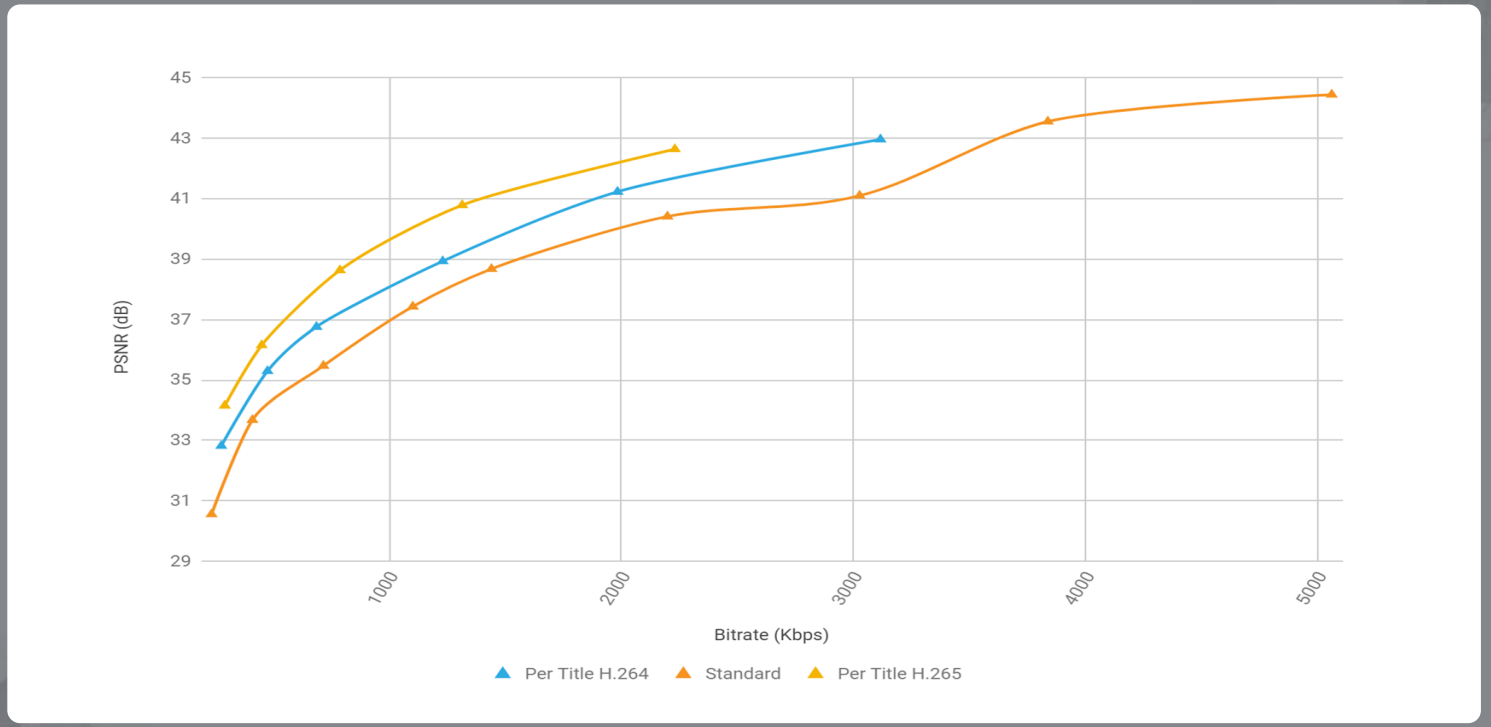
Bitrate (kbps)	Resolution
240	854 x 480
416.87	1024 x 576
792.05	1920 x 1080
1378.81	1920 x 1080
2400.26	1920 x 1080
Total Size	383.6 MB

Average Bitrate
2350 Kbps -> 1045.6 Kbps **(-56%)**

Storage Consumed
1363.2 MB -> 383.6 MB **(-72%)**

QOE (Full HD Available)
4500 Kbps -> 792.05 Kbps **(-82%)**

Golden Ladder vs Per-Title H.264 vs Per-Title H.265



Hulu Japan

Bitmovin technologies used:

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- Per-Title
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Result: Combine it all together for 30% CDN savings

China Region Experience

“Bitmovin has been by far the easiest encoding-as-a-service solution we’ve used so far. It allows us to process our videos and distribute them to both our Aliyun services in China and AWS servers in the US.”

— Co-CEO of BitTiger

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Thank you

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