Context-aware encoding and dynamic encoding ladders

Machine Learning for Per-Title Encoding

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Contents

1. Problem Statement

One-Size-Fits-All encoding

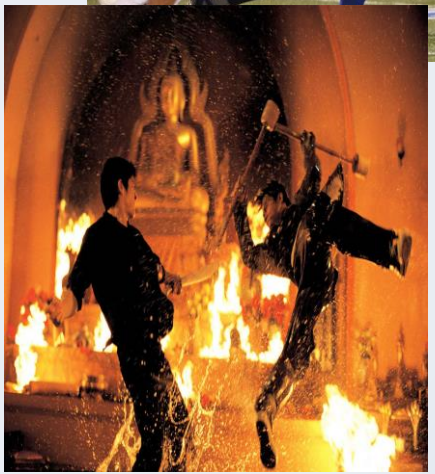
- **Motion** ⟶ **Low vs High**
- **Texture** ⟶ **Plain vs Complex**

- **Downside**
- For the scenes with high complexity ⟶ Blockiness or Blur
- For simple content like cartoons ⟶ Waste the bitrate

Bitrate (kbps)	Resolution
235	320x240
375	384x288
560	512x384
750	512x384
1050	640x480
1750	720x480
2350	1280x720
3000	1280x720
4300	1920x1080
5800	1920x1080

bitrate ladder

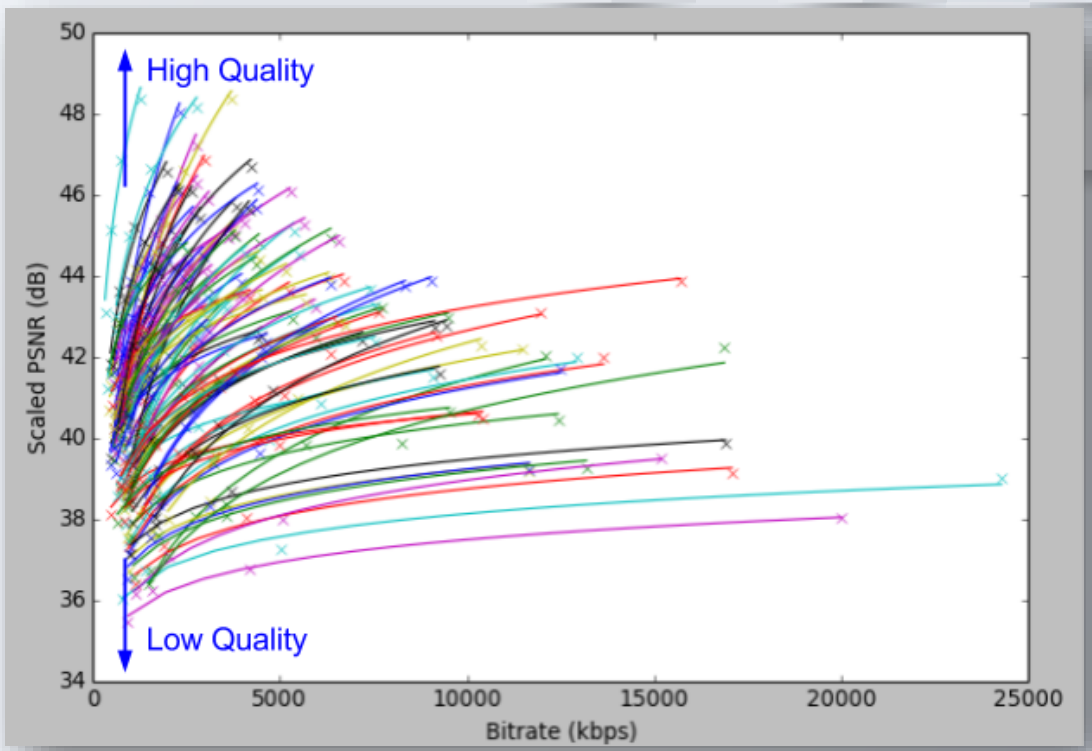
LOW Complexity



High Complexity

Quality-Bitrate curves for different contents

- 100 sources
- Resolution: 1080p

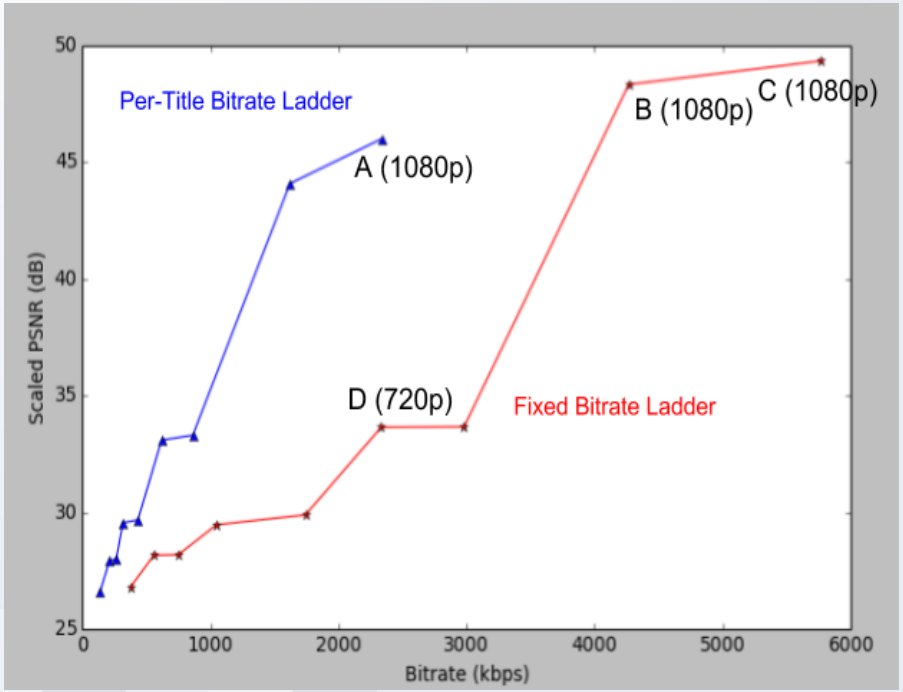


Quality Metrics

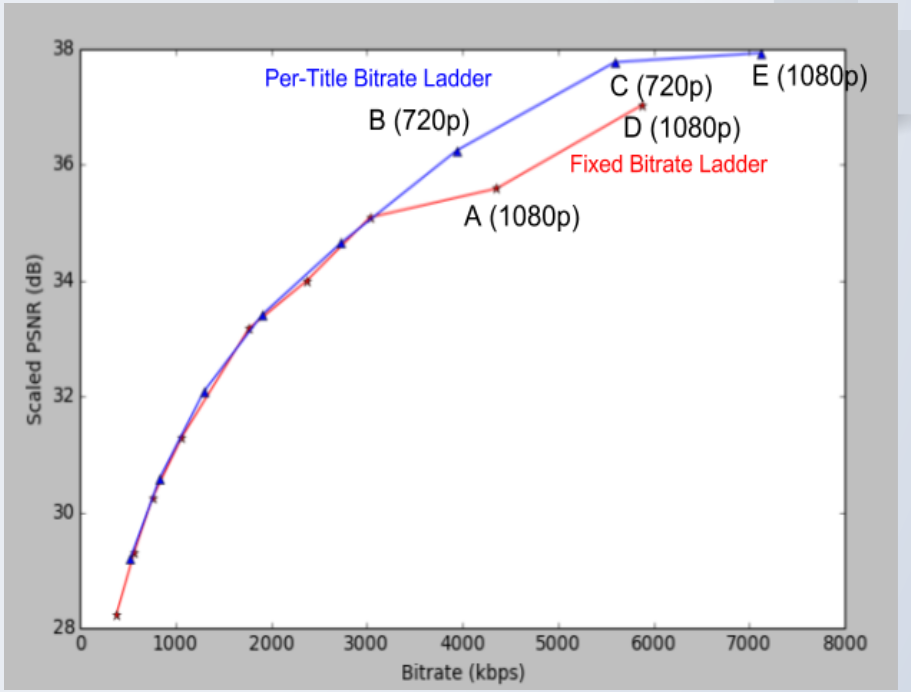
- **PSNR** (Peak Signal-To-Noise Ratio)
  - *The most commonly used metric in video compression.*
- **VMAF**(Video Multi-Method Assessment Fusion)
  - *Perceptual quality metric developed by Netflix*

Why Per-Title encoding?

- **Each title** receives a **unique bitrate ladder**, tailored to its specific **complexity** characteristics.



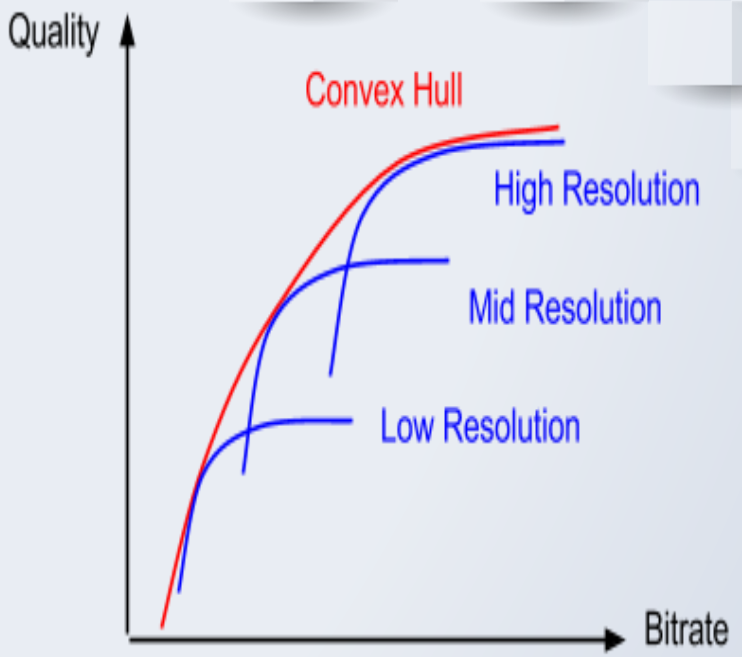
Fig(a): Simple Content



Fig(b): Complex Content

What is the Convex Hull ?

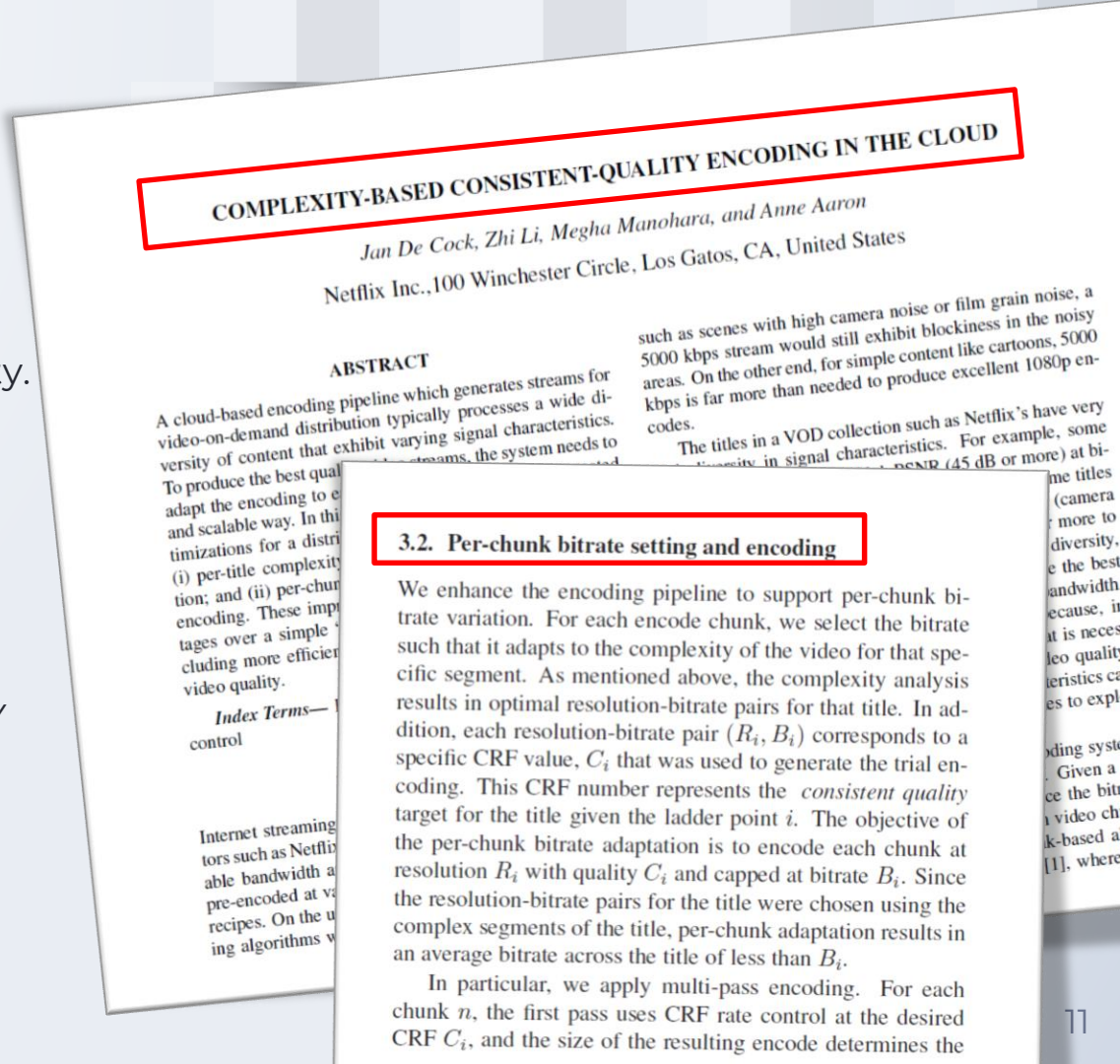
- **In order to design the optimal per-title bitrate ladder:**
- selection the bitrate-resolution pair for **each quality level**
- Efficiency of the selected bitrate-resolution pair (as high quality as possible).
- Being **below one JND** for two adjacent bitrates



Per-Chunk encoding

- Considering a title quality based on its chunks/segments quality.

- **The benefits**
  - Reduction of the *quality variation*
  - The increase of the *minimum quality*



COMPLEXITY-BASED CONSISTENT-QUALITY ENCODING IN THE CLOUD

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ABSTRACT

A cloud-based encoding pipeline which generates streams for video-on-demand distribution typically processes a wide diversity of content that exhibit varying signal characteristics. To produce the best qual... adapt the encoding to e... and scalable way. In thi... timizations for a distri... (i) per-title complexity... tion; and (ii) per-chun... encoding. These impr... tages over a simple ... cluding more efficien... video quality.

Index Terms— ... control

Internet streaming... tors such as Netfli... able bandwidth a... pre-encoded at v... recipes. On the u... ing algorithms w...

such as scenes with high camera noise or film grain noise, a 5000 kbps stream would still exhibit blockiness in the noisy areas. On the other end, for simple content like cartoons, 5000 kbps is far more than needed to produce excellent 1080p encodes.

The titles in a VOD collection such as Netflix's have very ... in signal characteristics. For example, some ... PSNR (45 dB or more) at bi... me titles (camera ... more to ... diversity, ... e the best ... andwidth ... ecause, ... at is neces... leo quality ... teristics ca... es to expl...

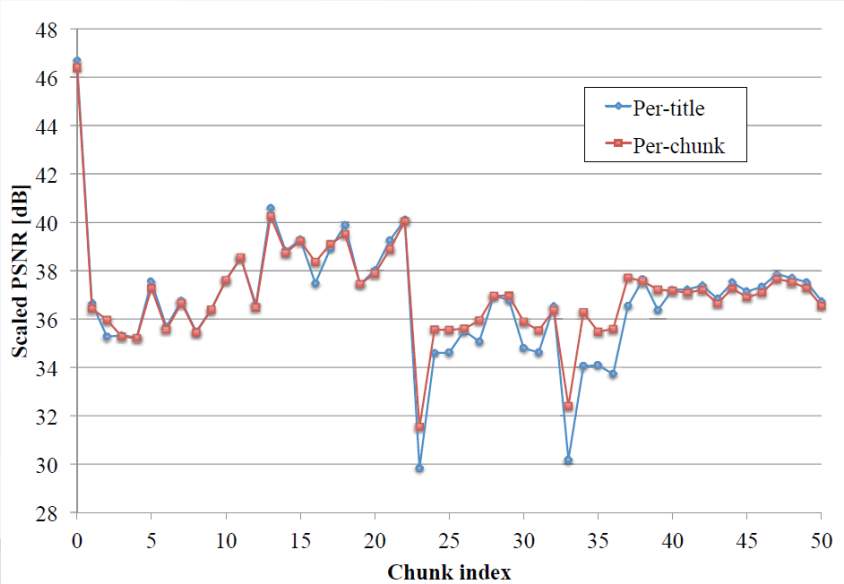
3.2. Per-chunk bitrate setting and encoding

We enhance the encoding pipeline to support per-chunk bitrate variation. For each encode chunk, we select the bitrate such that it adapts to the complexity of the video for that specific segment. As mentioned above, the complexity analysis results in optimal resolution-bitrate pairs for that title. In addition, each resolution-bitrate pair (R_i, B_i) corresponds to a specific CRF value, C_i that was used to generate the trial encoding. This CRF number represents the *consistent quality* target for the title given the ladder point i. The objective of the per-chunk bitrate adaptation is to encode each chunk at resolution R_i with quality C_i and capped at bitrate B_i. Since the resolution-bitrate pairs for the title were chosen using the complex segments of the title, per-chunk adaptation results in an average bitrate across the title of less than B_i.

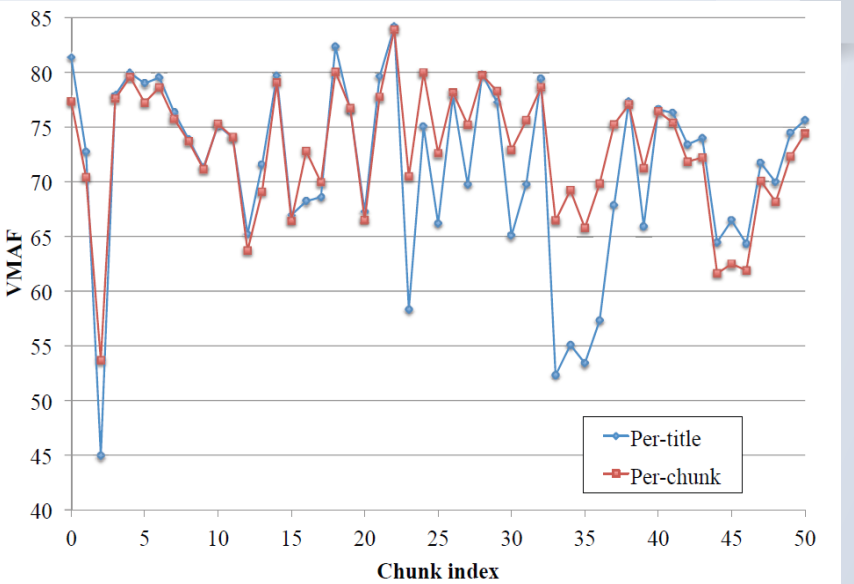
In particular, we apply multi-pass encoding. For each chunk n, the first pass uses CRF rate control at the desired CRF C_i, and the size of the resulting encode determines the

...ding syst... Given a ... ce the bitr... video ch... k-based a... [1], where...

Per-chunk vs Per-title encoding



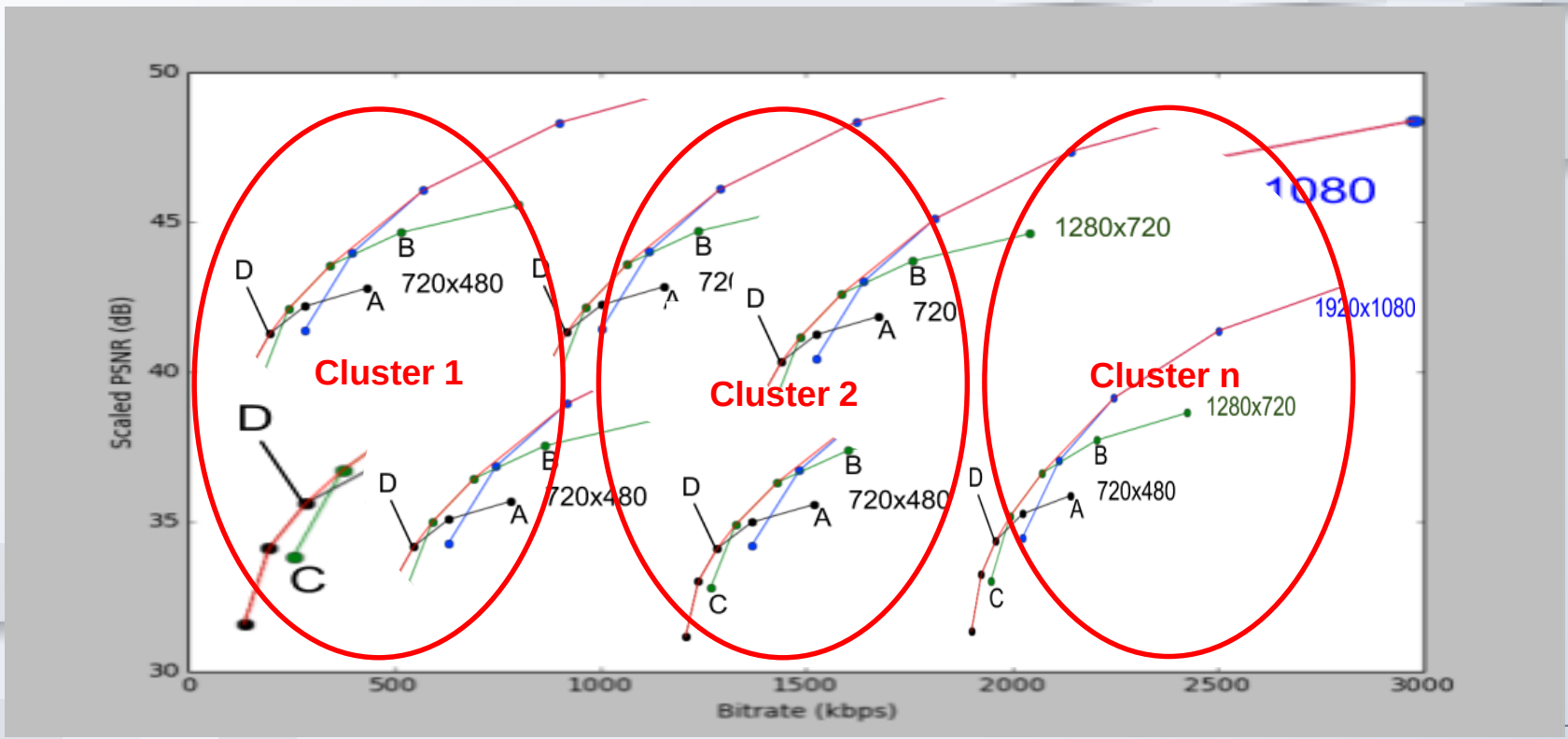
Fig(a)



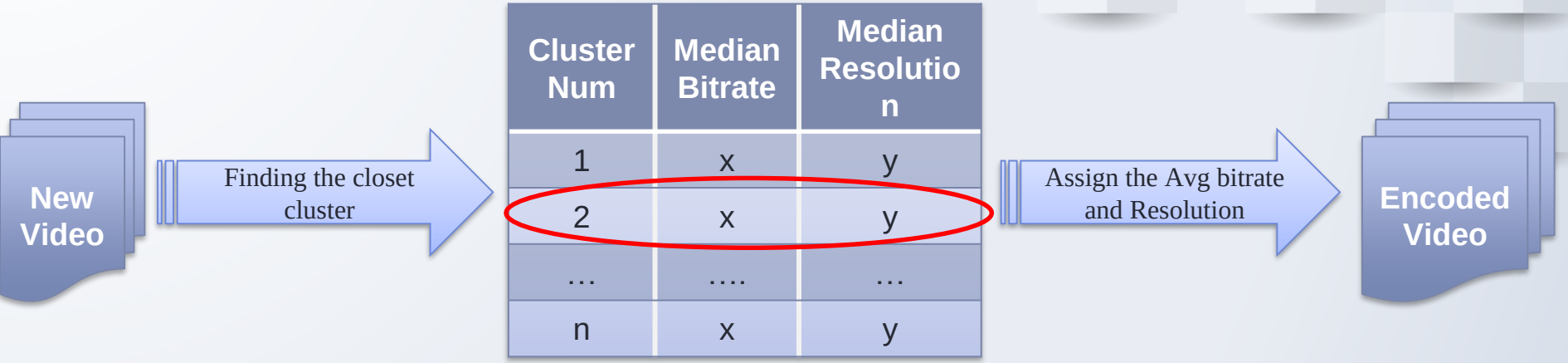
Fig(b)

The Goal ...

How to improve the encoding approaches using Machine Learning



How to improve the encoding approaches using Machine Learning



THANKS!

Any questions?