Fast Texture Compression using Image Segmentation

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Texture Compression

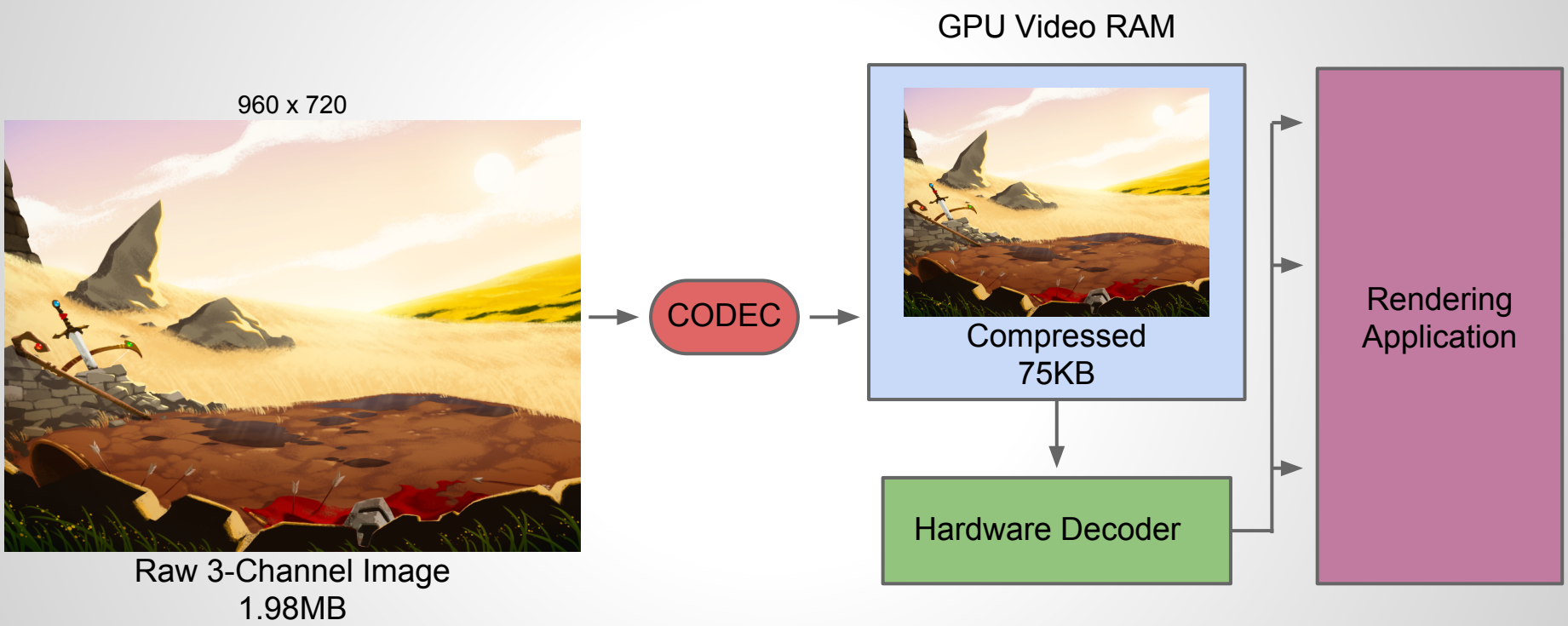


Image Compression

PNG
706KB

JPEG
124KB

960 x 720

Hard Disk Storage

CODEC 1

RAW
1.98MB

CPU RAM

CODEC 2

ASTC
75KB

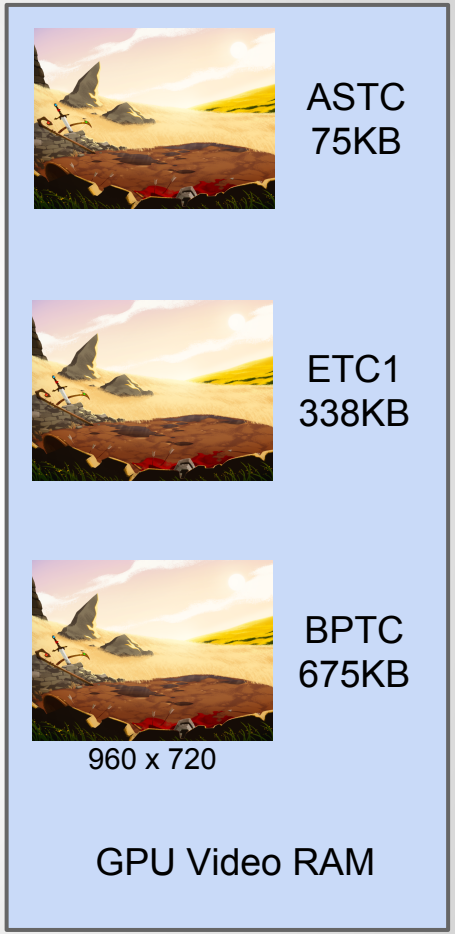
ETC1
338KB

BPTC
675KB

960 x 720

GPU Video RAM

Problem: Slow Codecs



This step is really slow!

Just do it offline

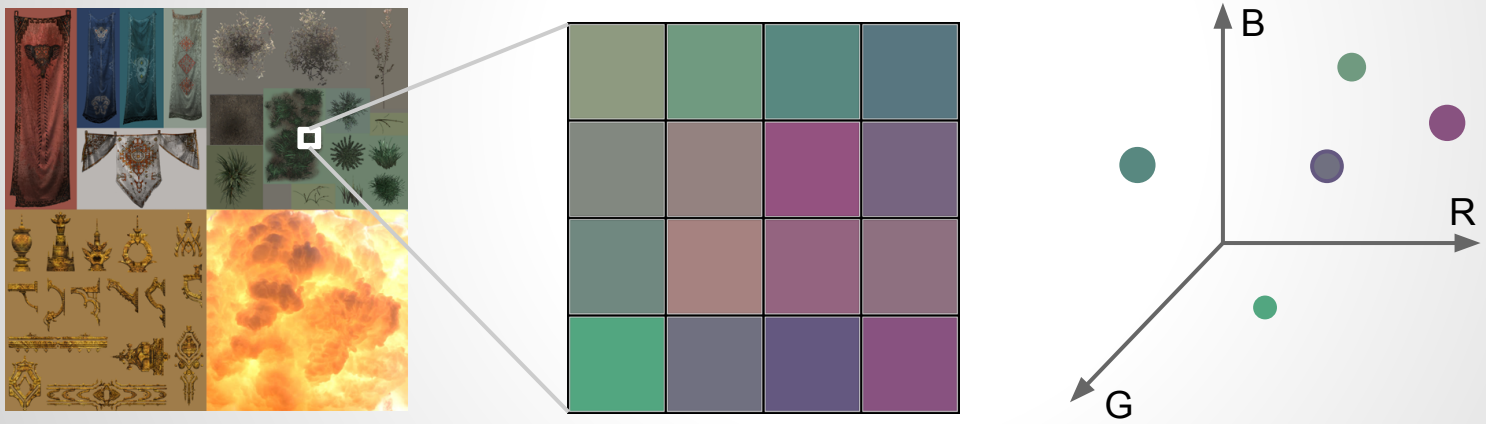
So why make it fast?

- Faster iteration for content creation
- Opens up on-the-fly compression applications:
  - Vector graphics
  - Framebuffer Operations
  - etc...

Overview:
Block Compression

Block Compression

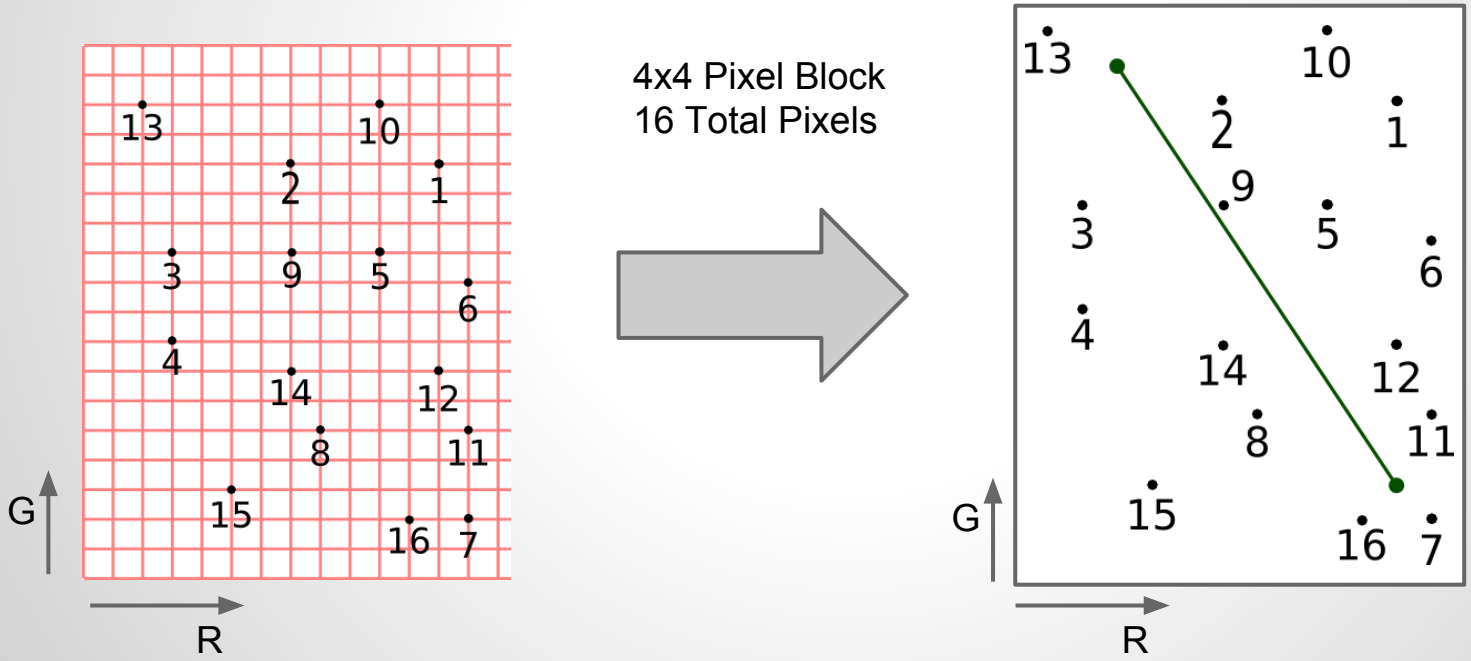
Consider 4x4 blocks of pixels



DXT: [Iourcha et al. ‘99] BPTC: [Donovan et al. ‘10] ASTC: [Nystad et al. ‘12]

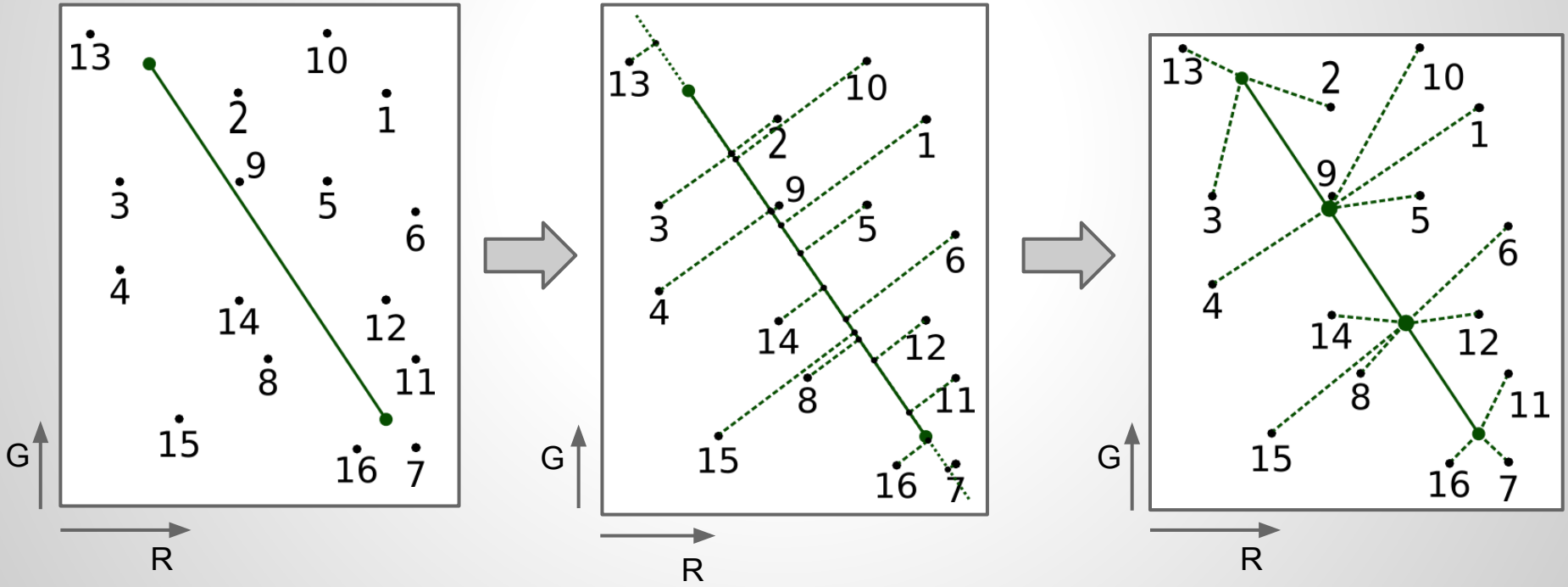
Block Compression

Approximate point set by a line in this space



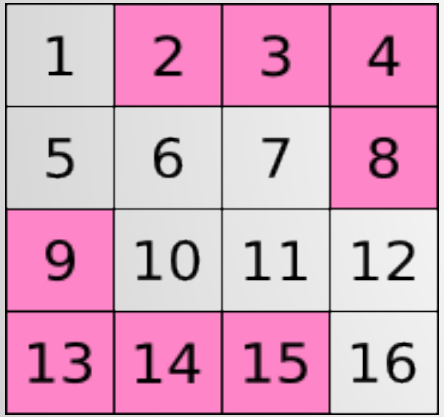
Block Compression

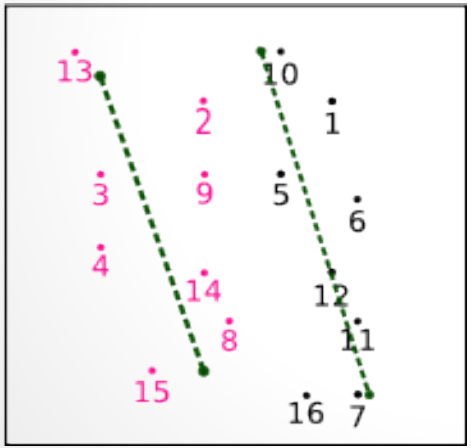
For each pixel, just save an interpolation value

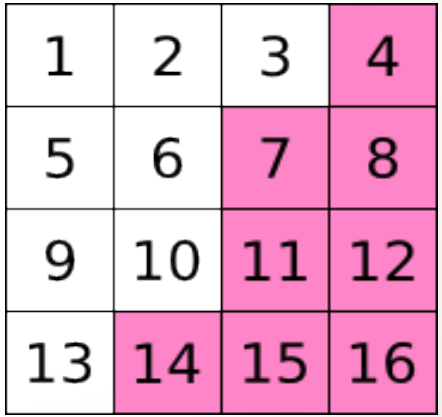


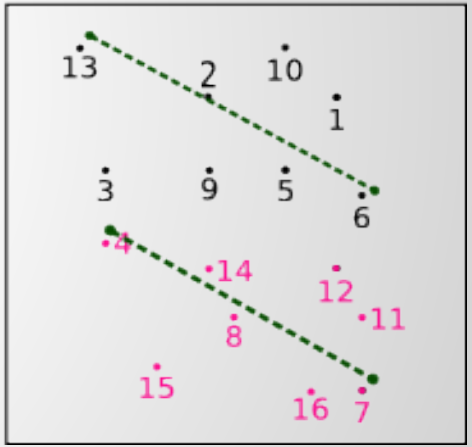
Partitioning

Use different segments for disjoint subsets



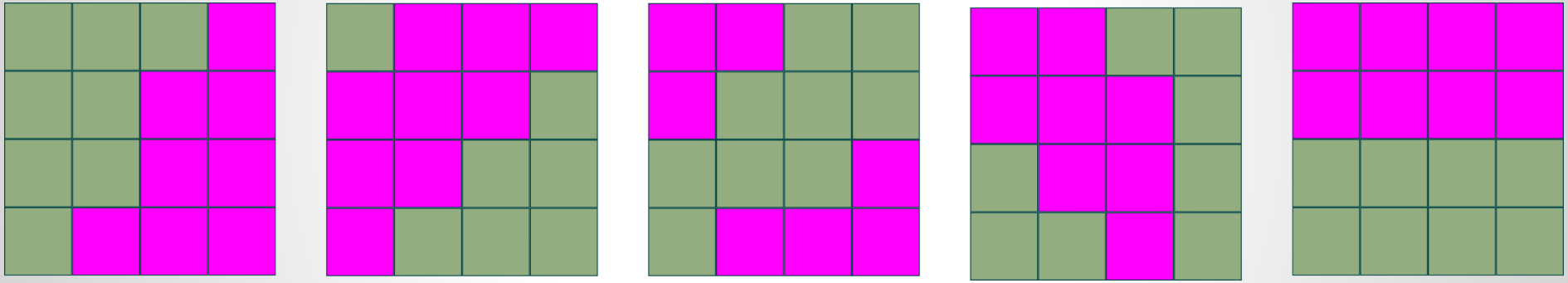






Limited Partitioning

To save bits: select from predefined set



BPTC 4x4
128 unique

ASTC 12x12
3123 unique

Problem:
How do we select the proper partition?

Solution 1: Approximate

1. Sort the partitionings based on a rough estimate of the compression error
2. Only consider the best few partitions for compression

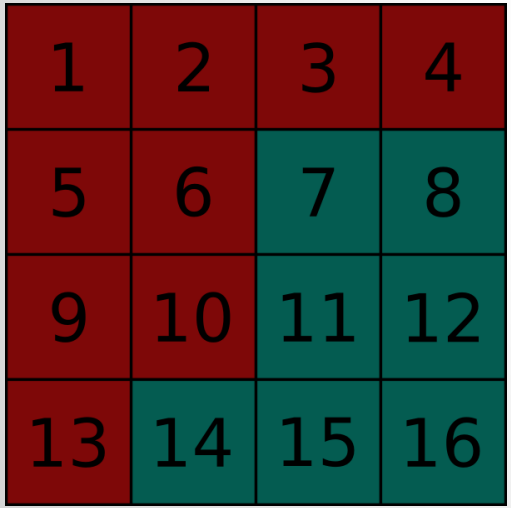
Used by most BPTC compressors:

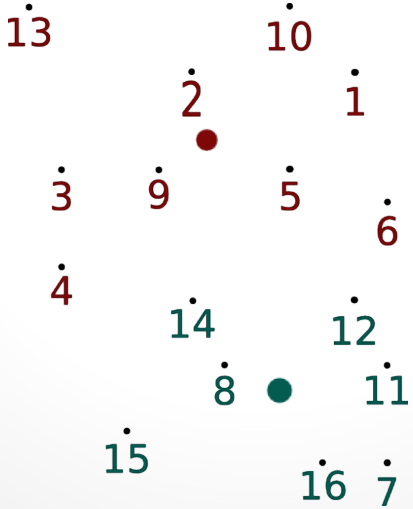
[Donovan ‘10] [Krajcevski et al. ‘13]

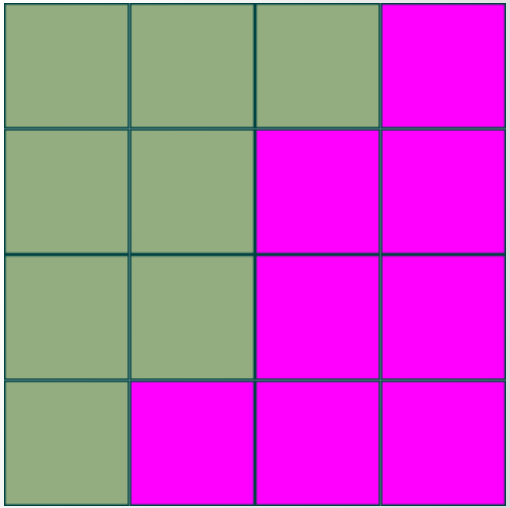
[Dufresne ‘13]

Solution 2: Estimate best shape

Use k-means [Nystad et al. ‘12]

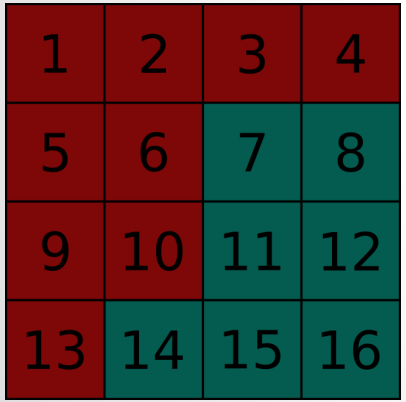


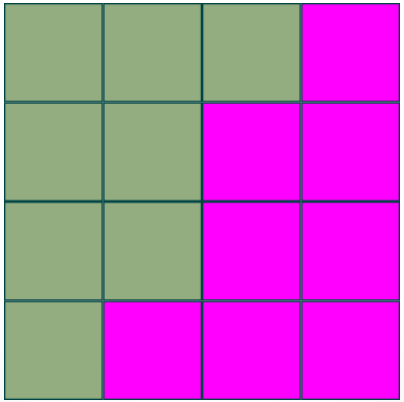
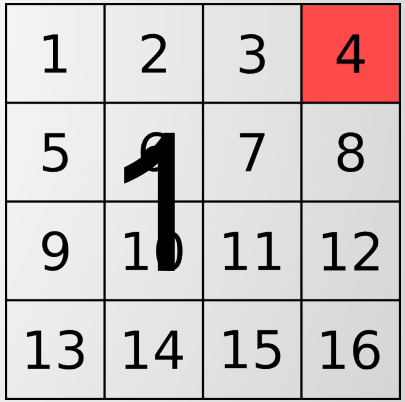




What is our metric?

The number of pixels different:

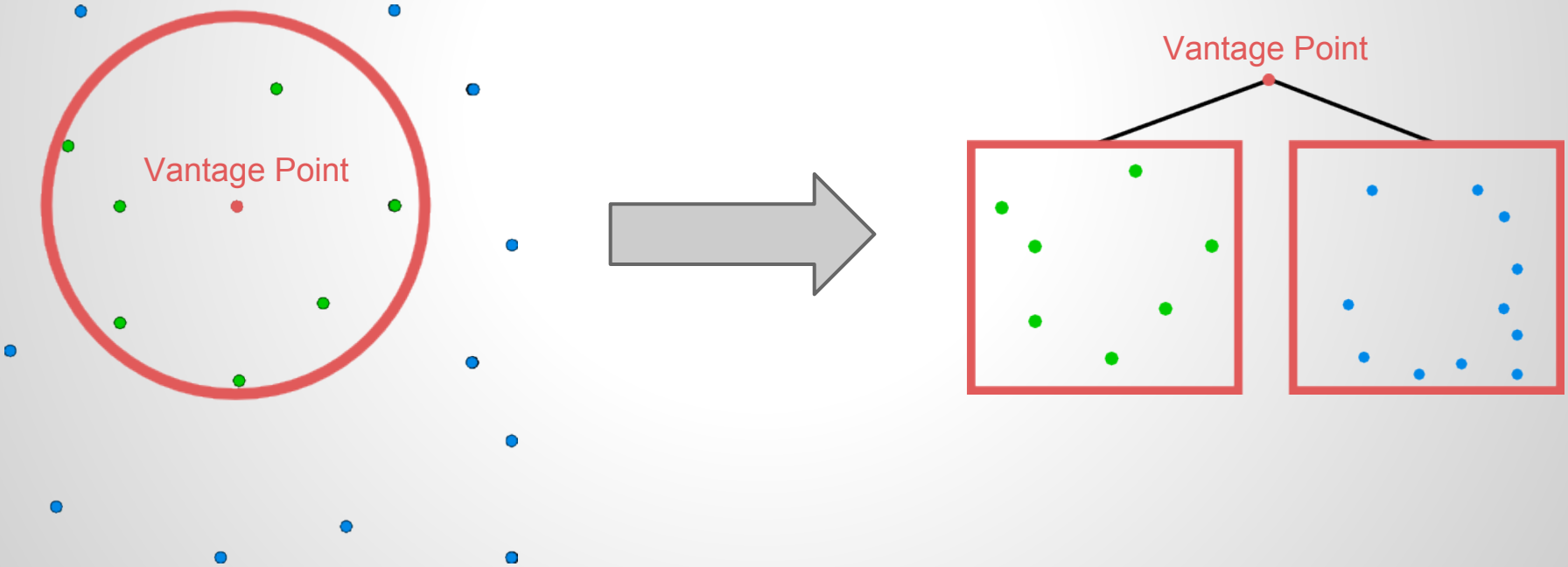
d(

, 
) = 

1

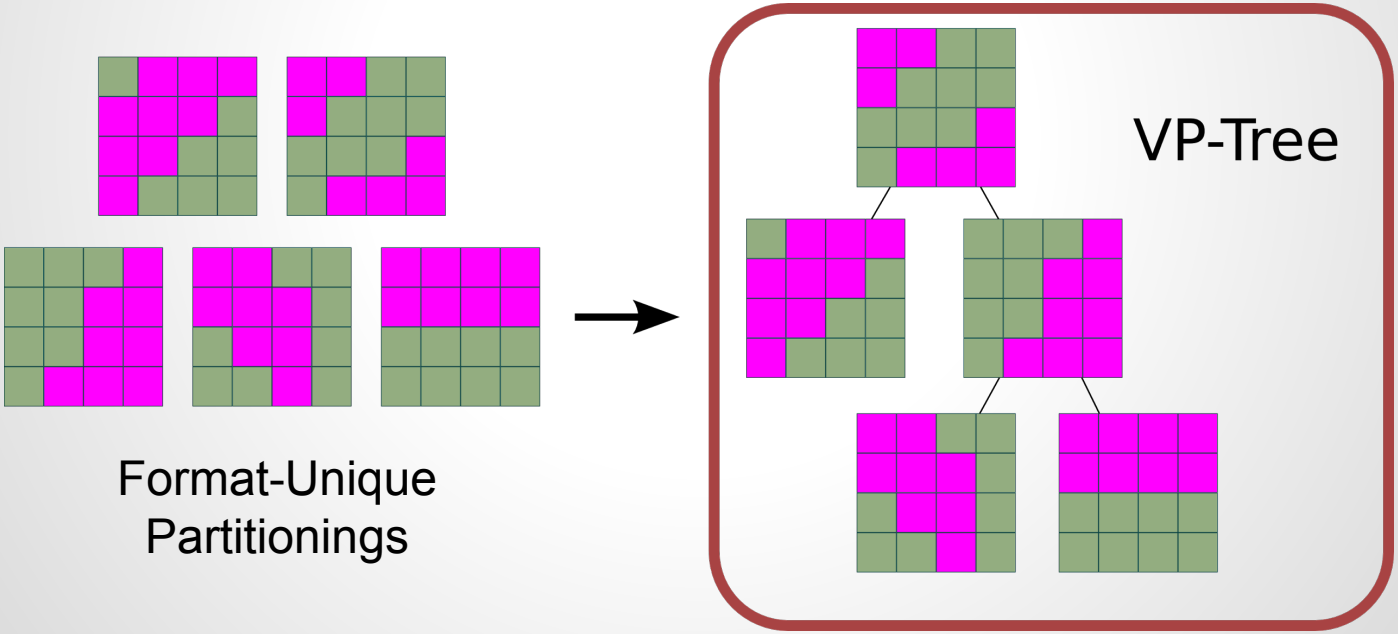
Acceleration Structure

Vantage Point Tree (VP-Tree) [Uhlmann ‘91]



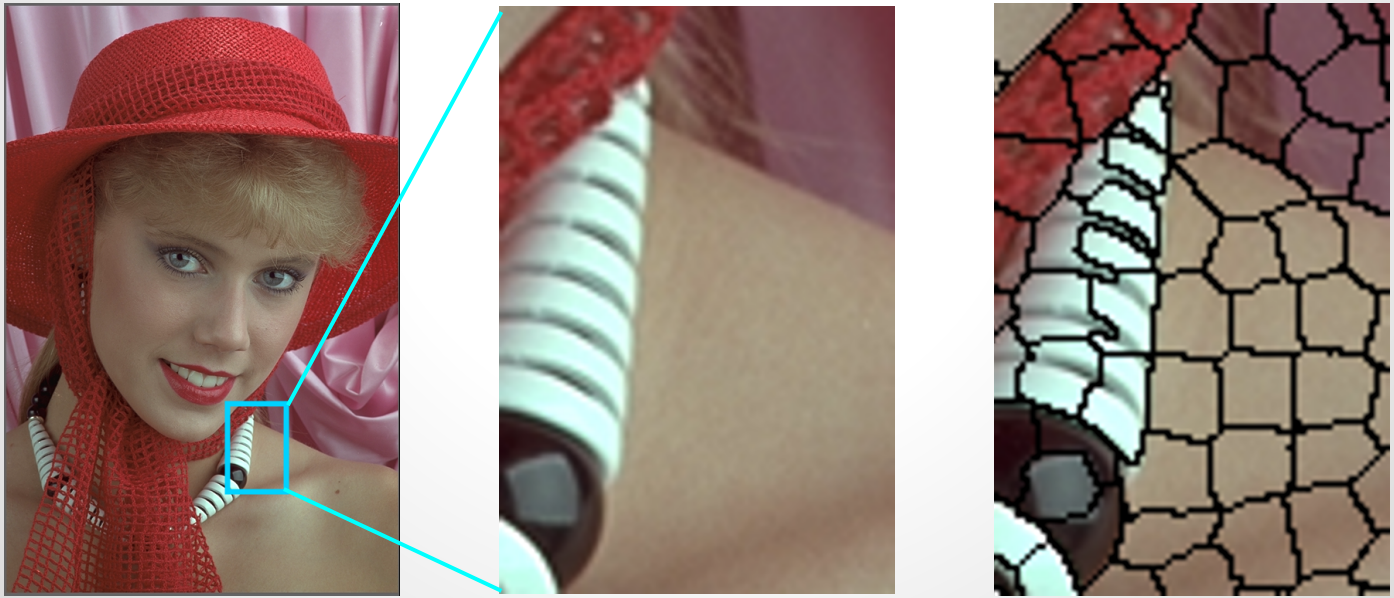
Our Method: Preprocessing

Organize existing partitionings into a VP-Tree:



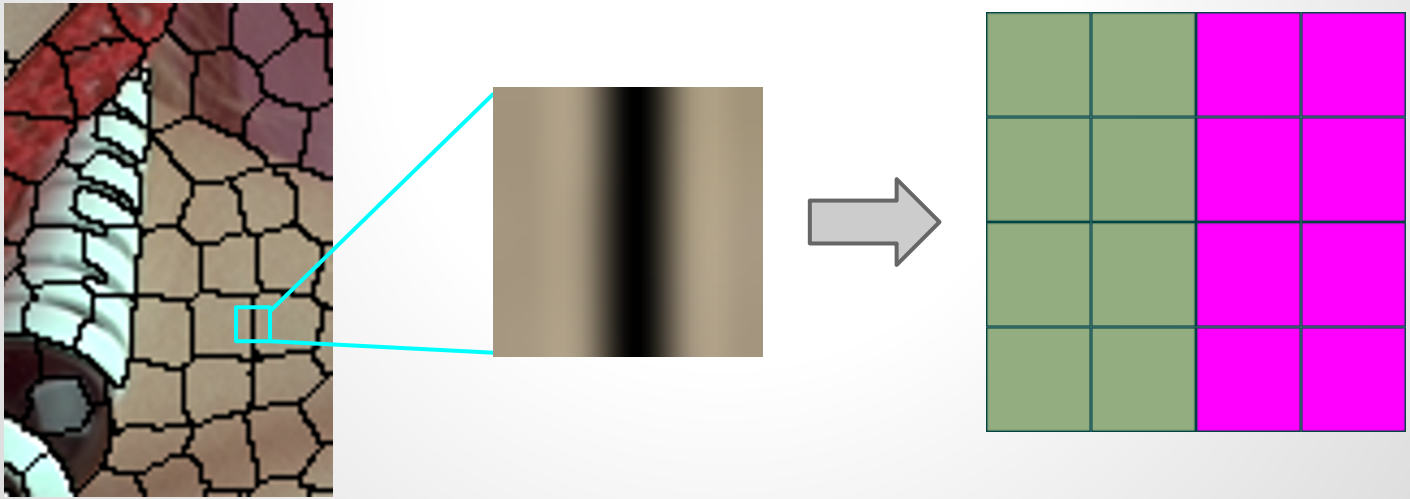
Our Method: Image Segmentation

Step one: Compute a segmentation



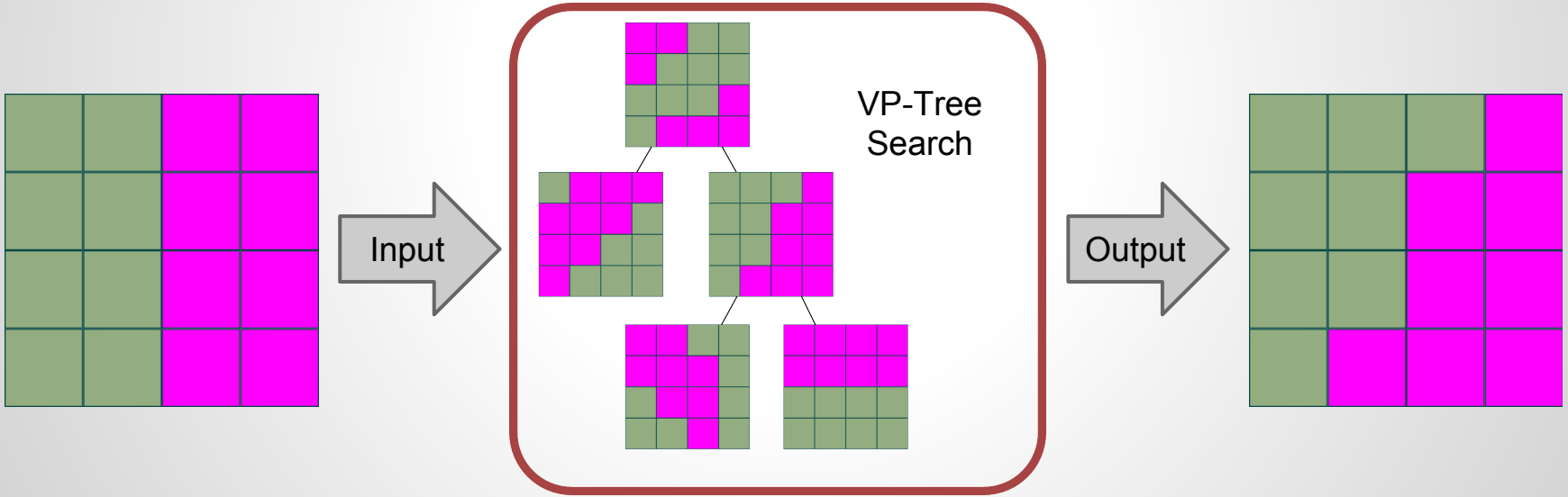
Our Method: Extract Partitioning

Calculate partitioning from segmentation boundaries



Our Method: Lookup Partition

Find the best partition from the VP-Tree



Results

Performance

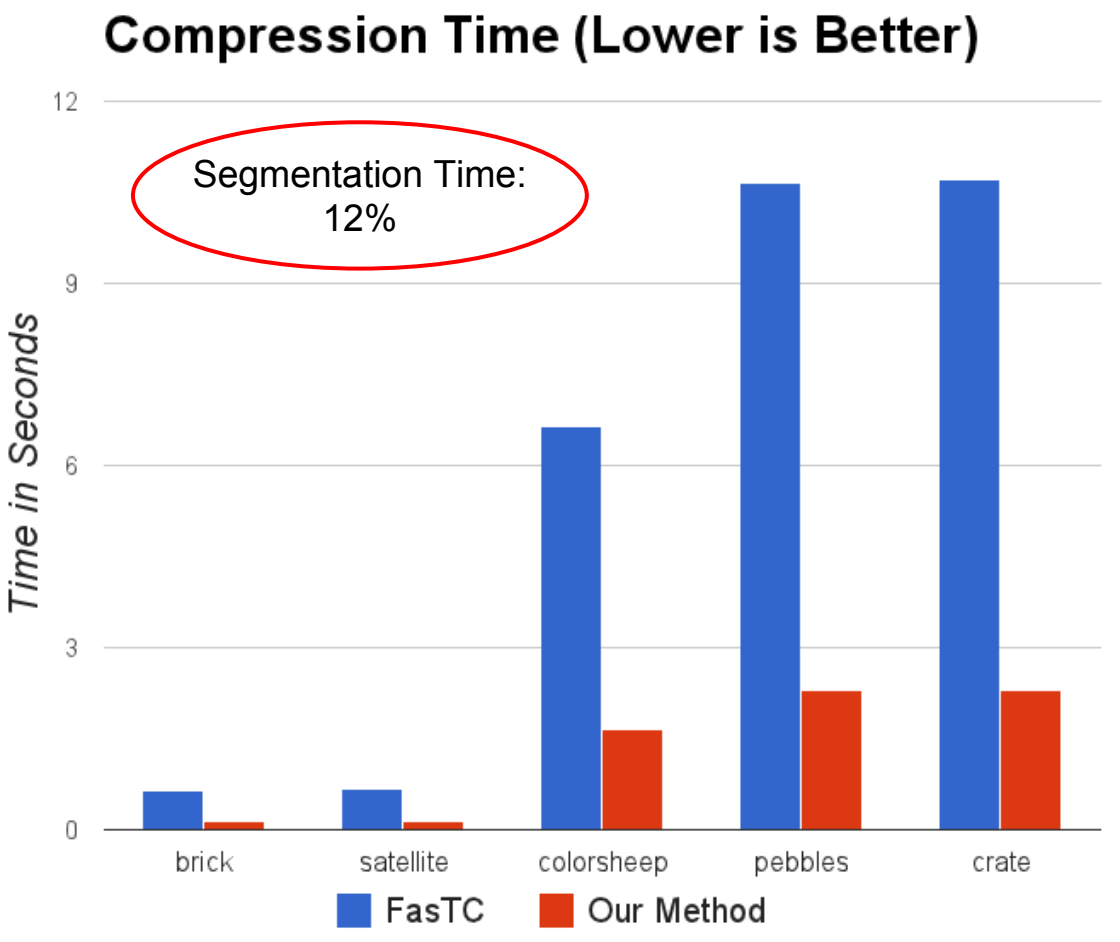
brick
256x256

satellite
256x256

pebbles
1024x1024

colorsheep
960x720

crate
1024x1024



Compression Quality

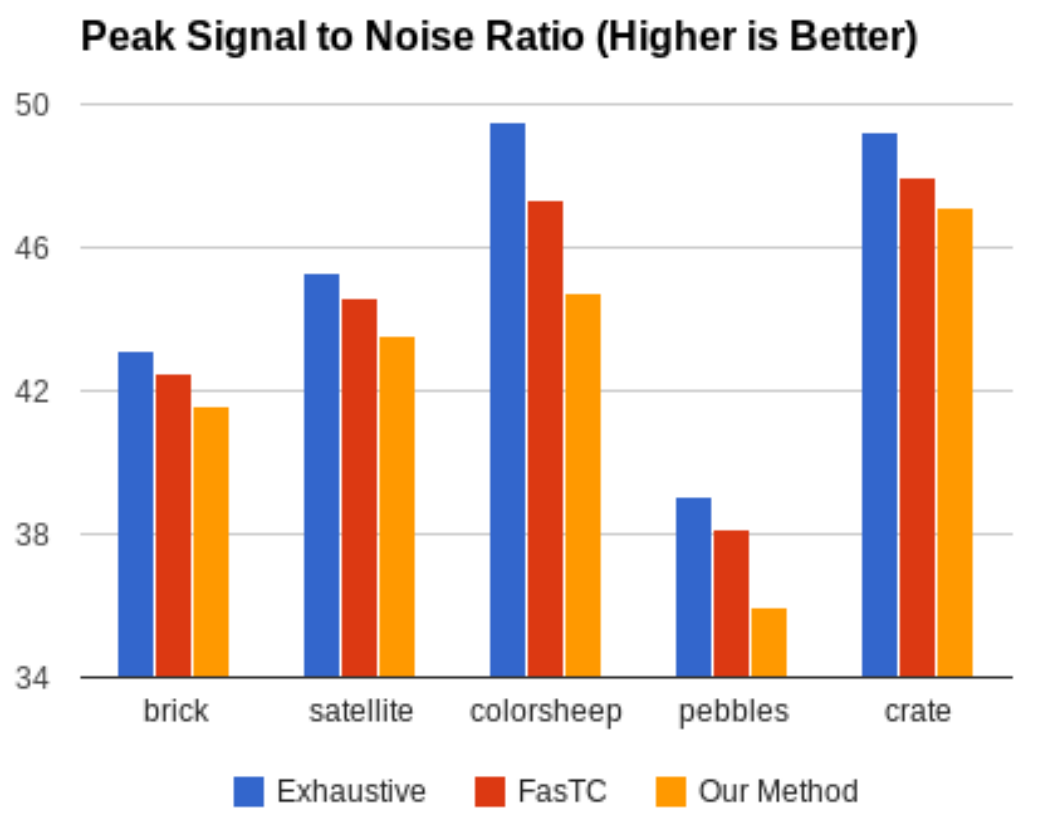
brick
256x256

satellite
256x256

pebbles
1024x1024

colorsheep
960x720

crate
1024x1024



Compression Quality

Exhaustive

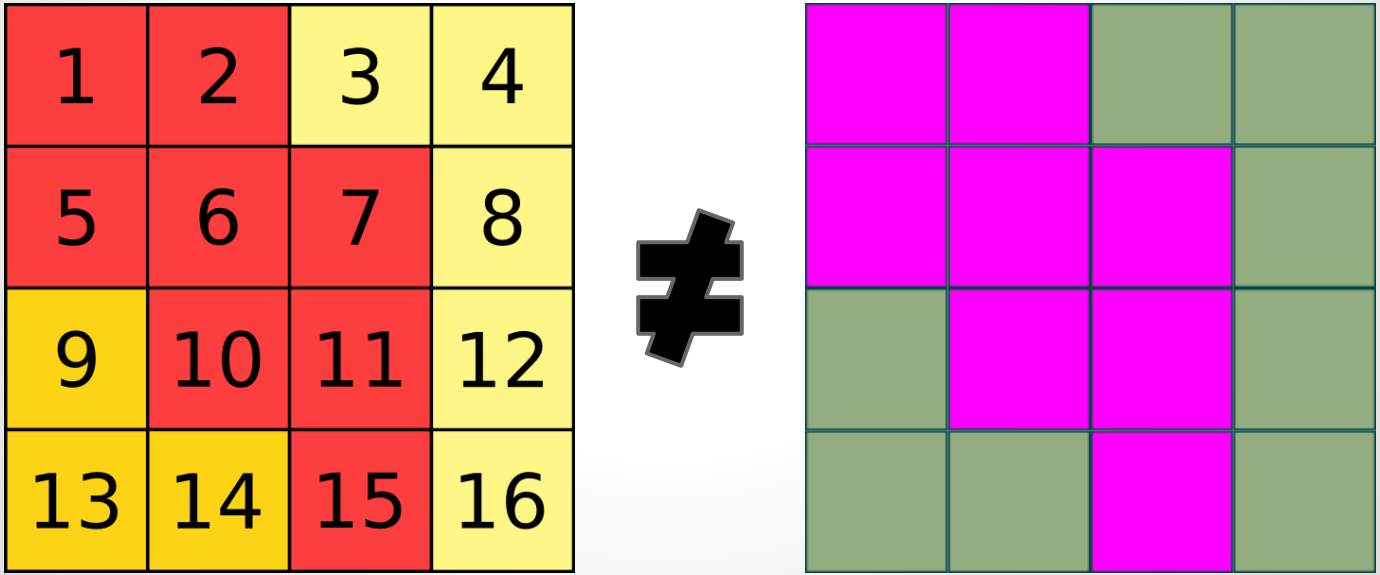
FasTC

Our Method

Limitations

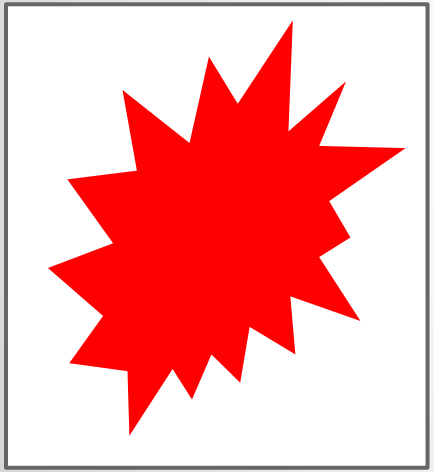
Limitations

Metric isn’t perfect - ideally these should match

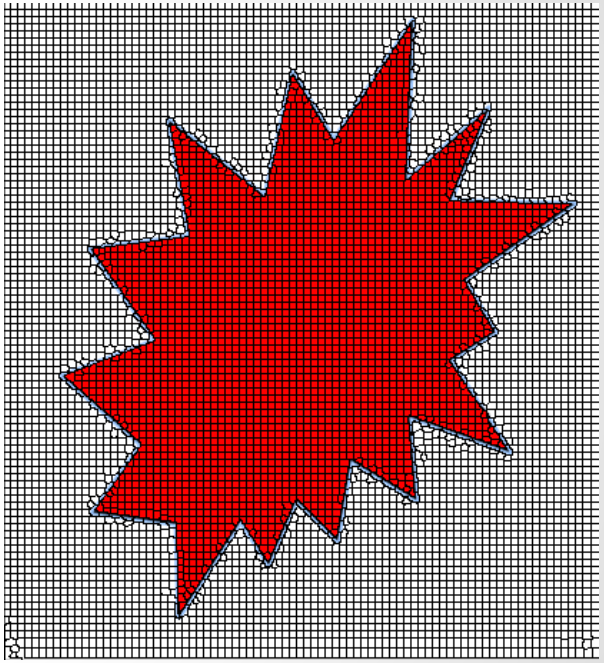


Limitations

Segmentation isn’t perfect



This should have two segments.



Limitations

Bits spent on partitionings can be better spent on compression parameters

Future Work

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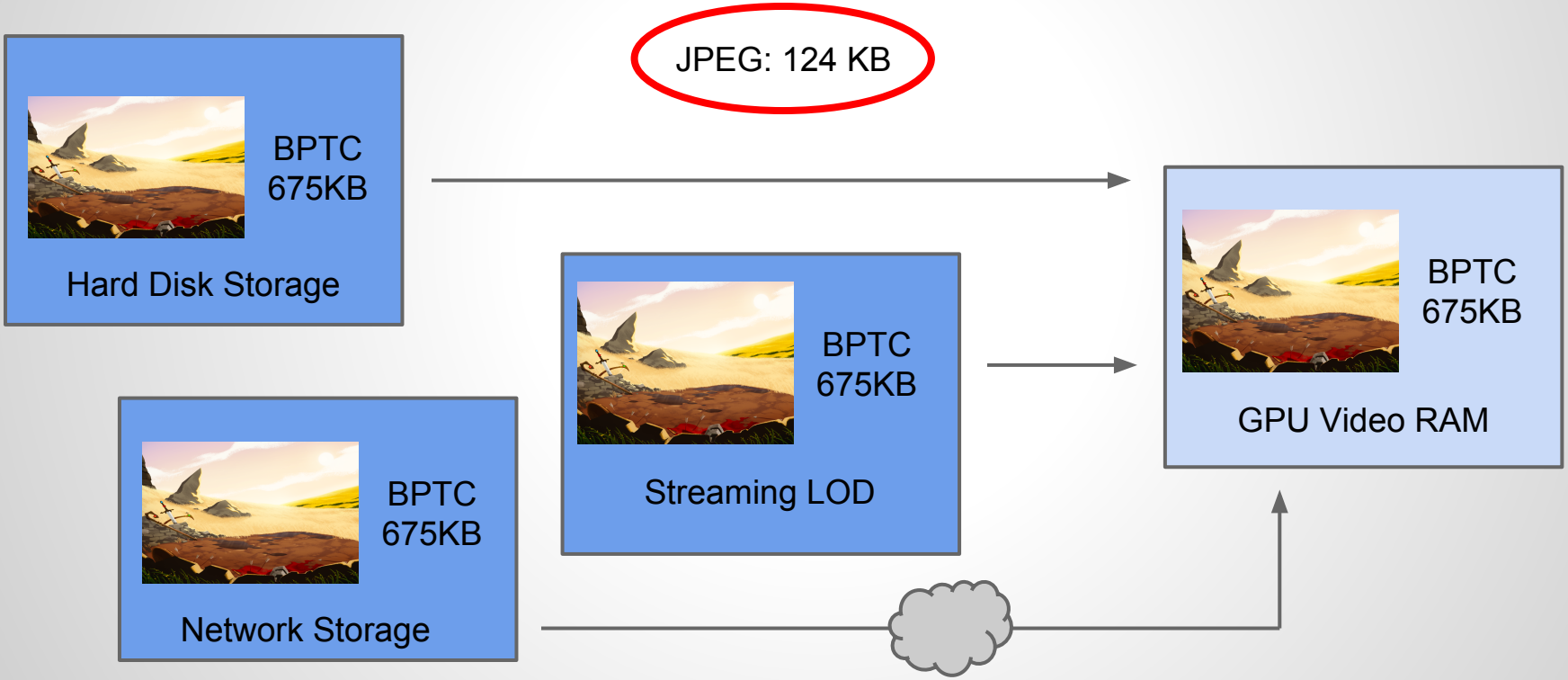

JPEG: 124 KB
BPTC
675KB
Hard Disk Storage
BPTC
675KB
Streaming LOD
BPTC
675KB
GPU Video RAM
BPTC
675KB
Network Storage

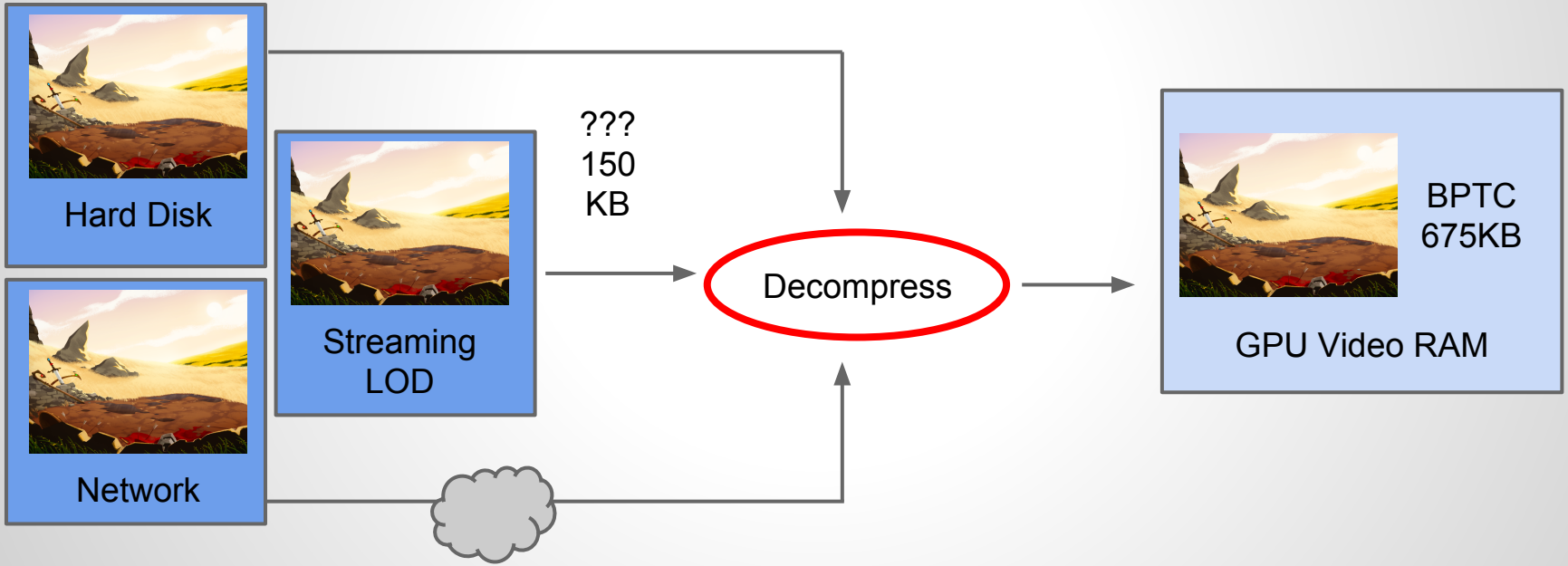
Future Work

Segmentation reduces entropy

PNG: 63.3 KB

PNG: 4 KB

Future Work


Hard Disk
Network
Streaming
LOD
???
150
KB
Decompress
BPTC
675KB
GPU Video RAM

Acknowledgements

- HPG Reviewers (Thank you!)

- ARO, NSF, and Intel for their support.

Questions?