



Light Field Compression Using View Synthesis

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and Panos Nasiopoulos

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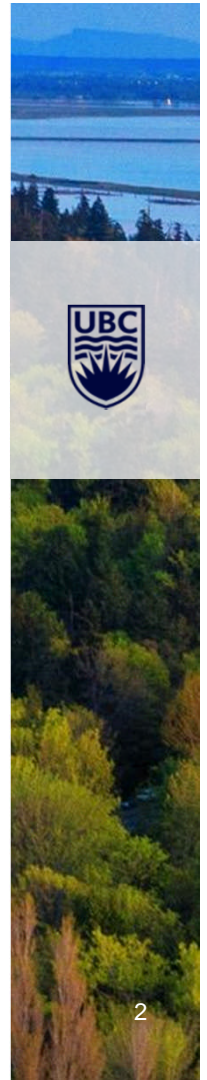
ABOUT ME!

M.A.Sc student in Computer Engineering

Member of the Digital Multimedia Lab @ UBC

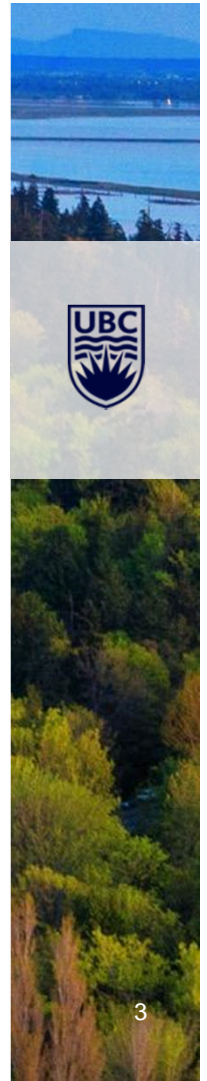
My interests:

- Computer Vision
- Imaging and Image Processing
- Compression of Visual data



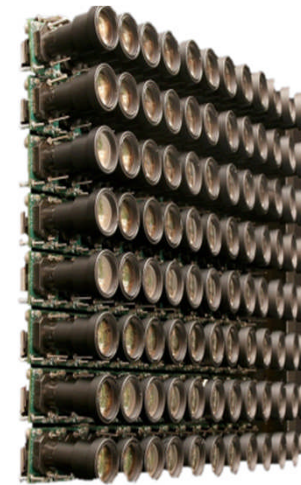
Outline

- Introduction AND Background
- Related Work
- Our Proposed Compression Approach
 - LF Compression
 - View Synthesis
- Evaluation and Analysis
- Conclusions



Light Field Technology

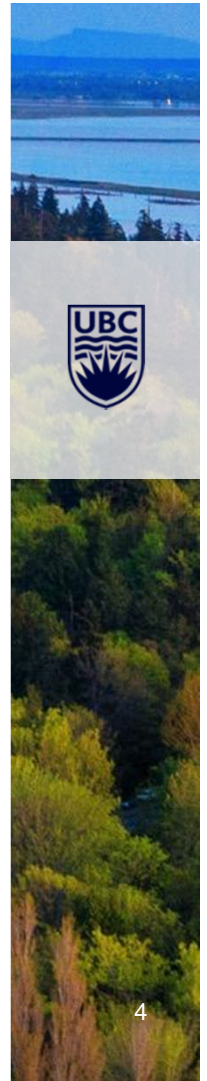
- MicroLens and Camera Array
- Direction of Light and Depth Detail
- Generates Multiple Views from different angles
- Adjust focus and perspective after capturing



Raytrix



Lytro



ENTERTAINMENT – LIGHT FIELD (perspective)



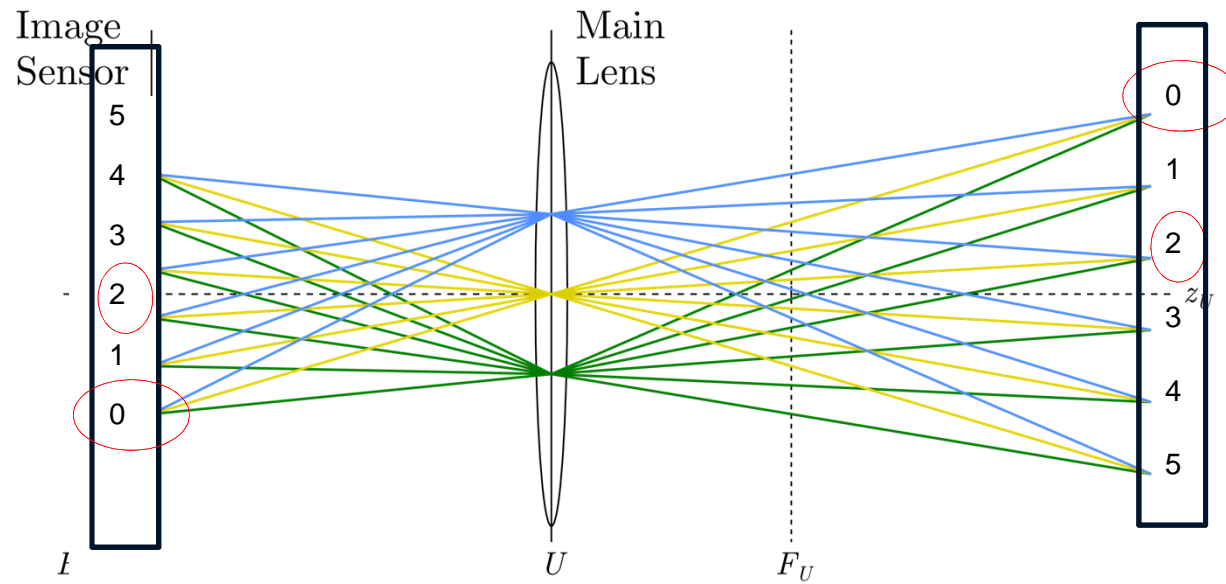


LIGHT FIELD (refocus)



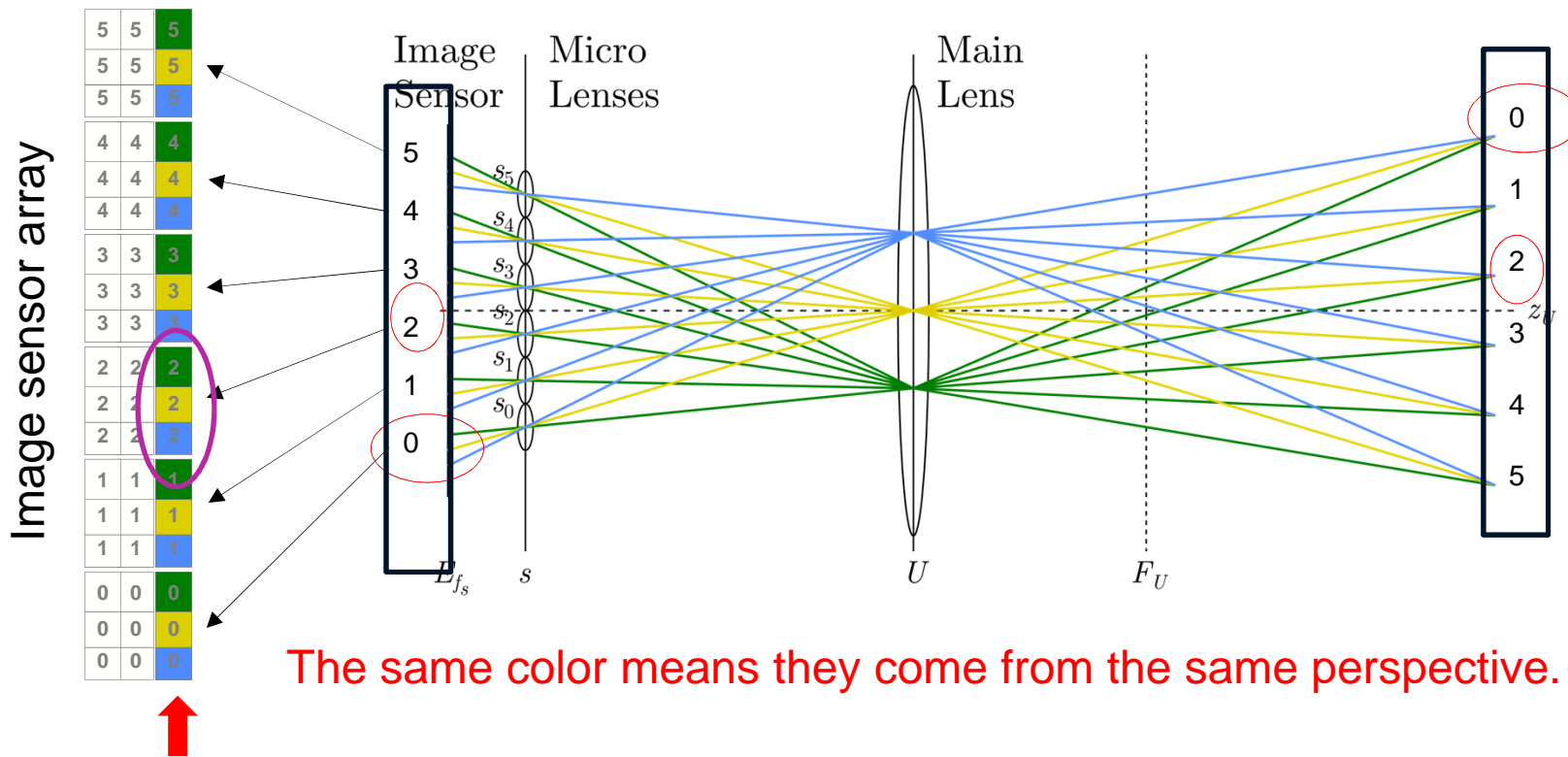
Basic Camera

Simplified model (Constant)



Light Field Camera – Concept of Sub-Aperture Images

Simplified model (Constant)



Light Field Camera – Concept of Sub-Aperture Images

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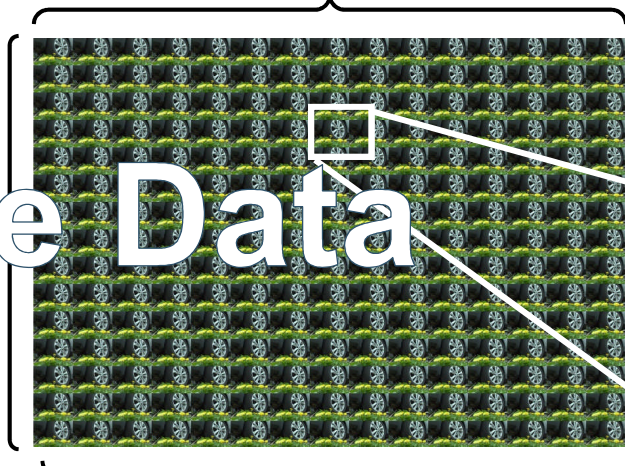


9375 (15x625)

↑ RAW light field image captured by sensors

6510 (15x434)

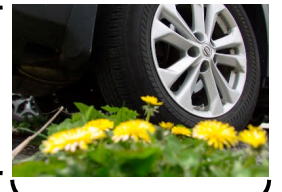
Massive Data



9375

↑ Processed sub-aperture images

434 px

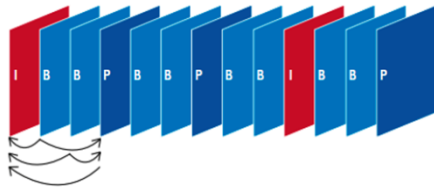


Single sub-aperture image

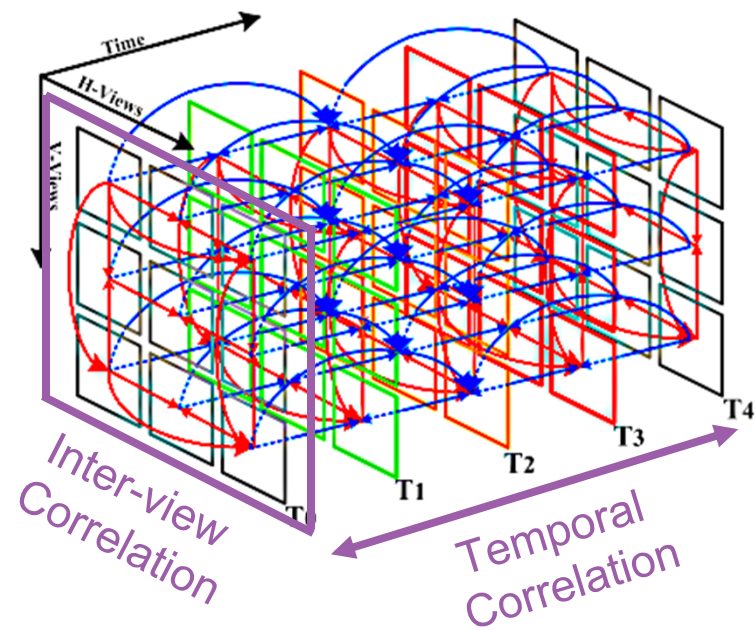
625 px

LIGHT FIELD – MASSIVE DATA: COMPRESSION

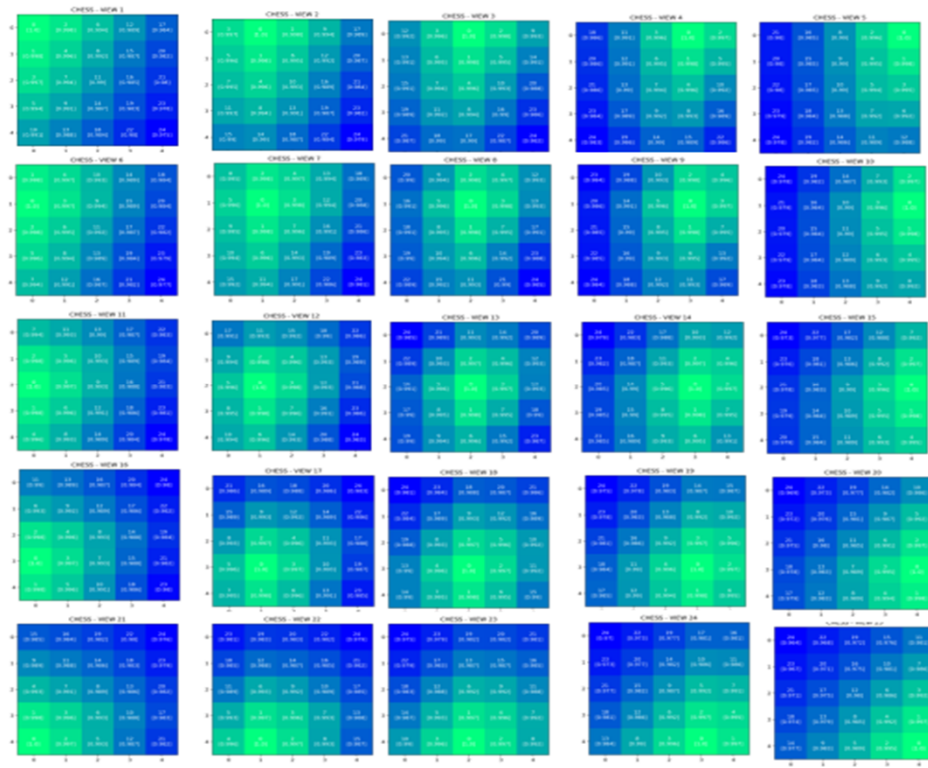
Conventional Video



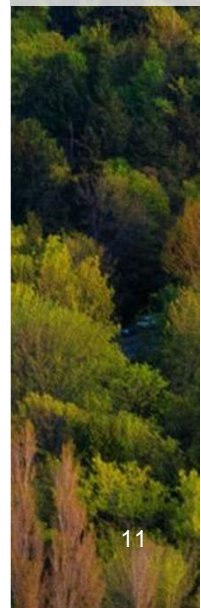
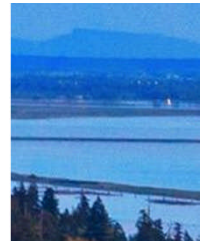
Light Field Video



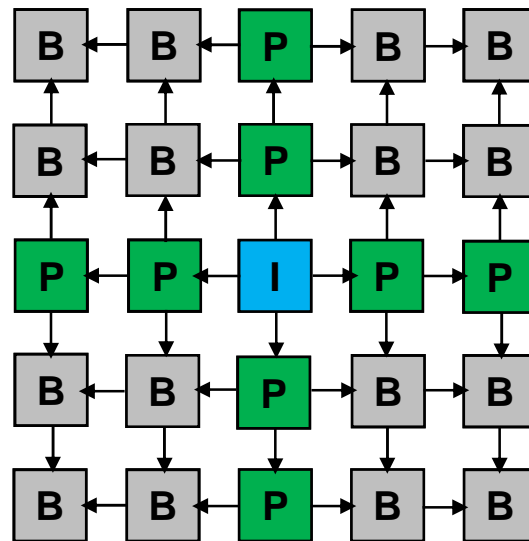
SSIM Strategy



.982	.985	.985	.984	.976
.983	.985	.986	.985	.981
.984	.99	.991	.989	.985
.984	.987	.99	.986	.984
.98	.981	.984	.982	.984

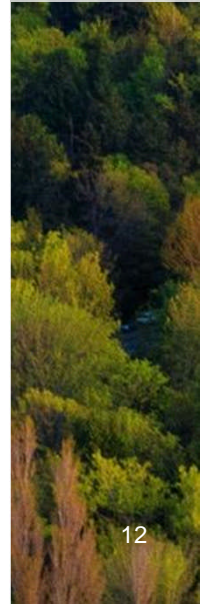
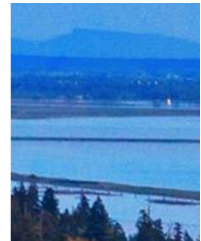


SSIM Strategy

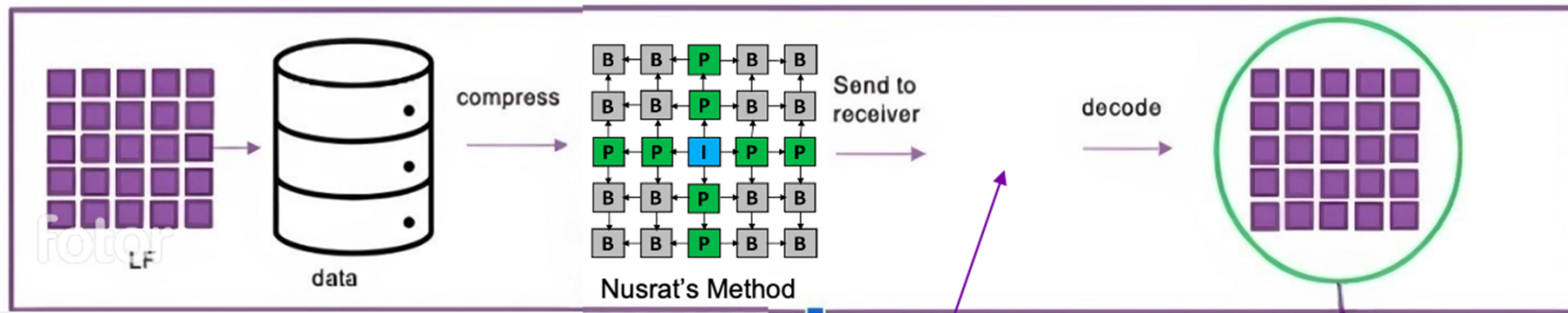


Best compression structure

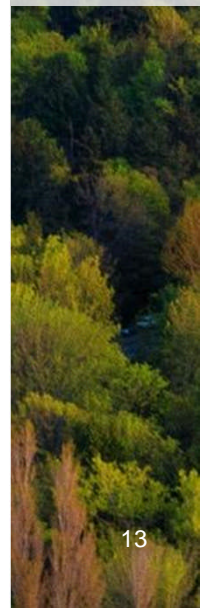
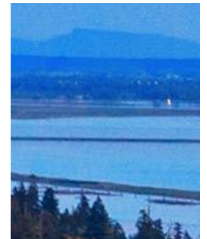
.982	.985	.985	.984	.976
.983	.985	.986	.985	.981
.984	.99	.991	.989	.985
.984	.987	.99	.986	.984
.98	.981	.984	.982	.984



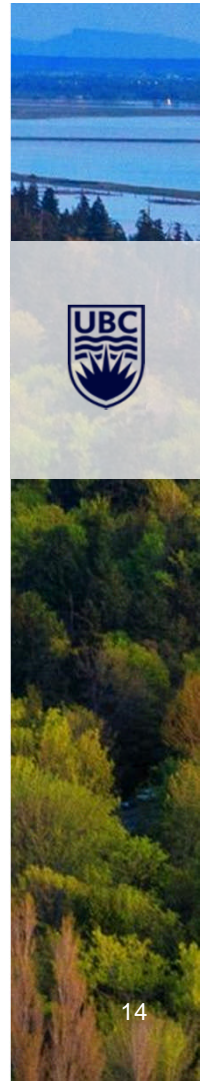
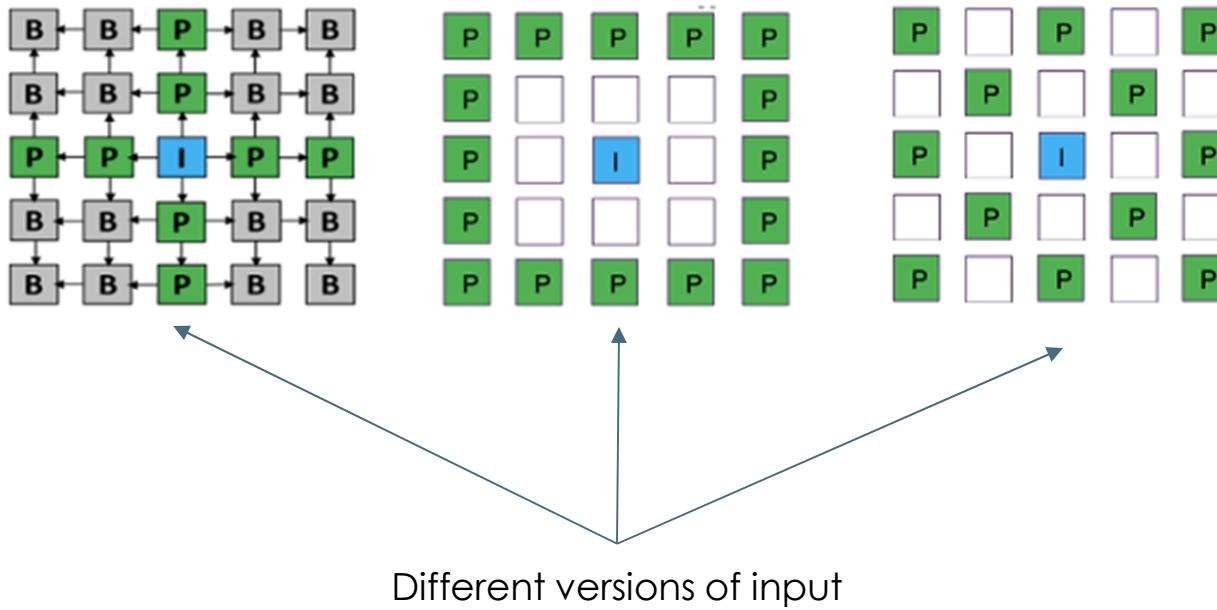
Problem Statement : Huge Amount of Data



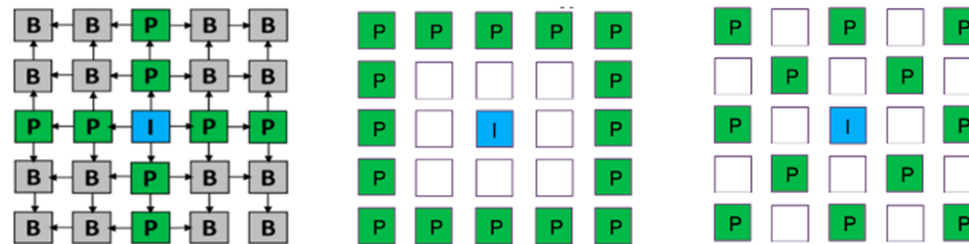
Still huge amount of bandwidth required!



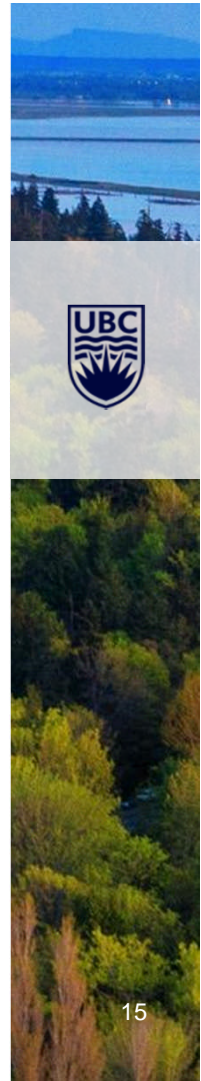
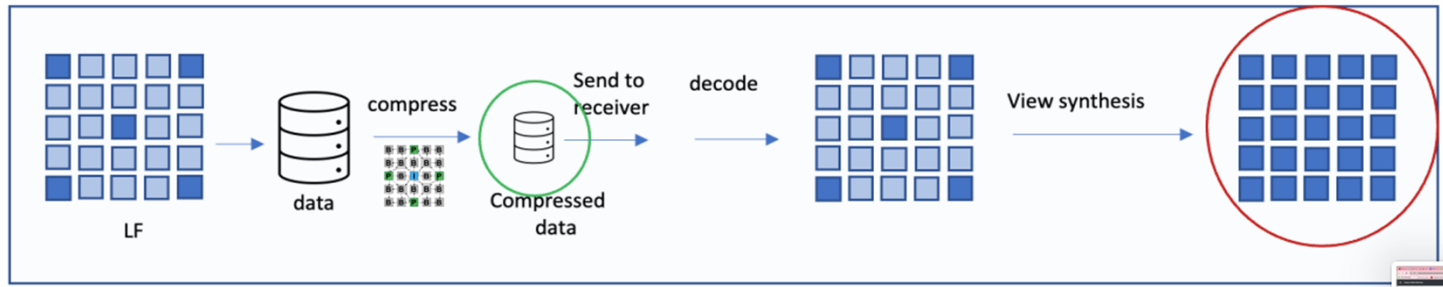
Our Proposed Solution - Choice of Compression Approach



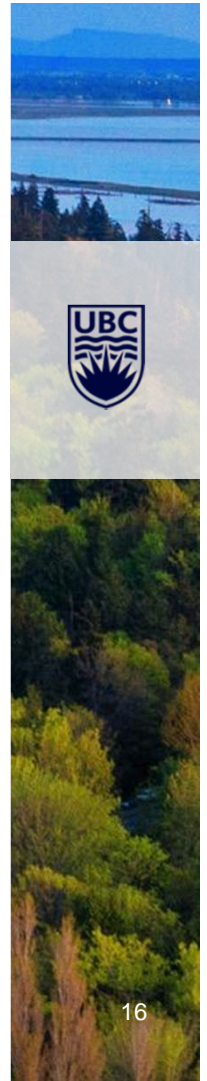
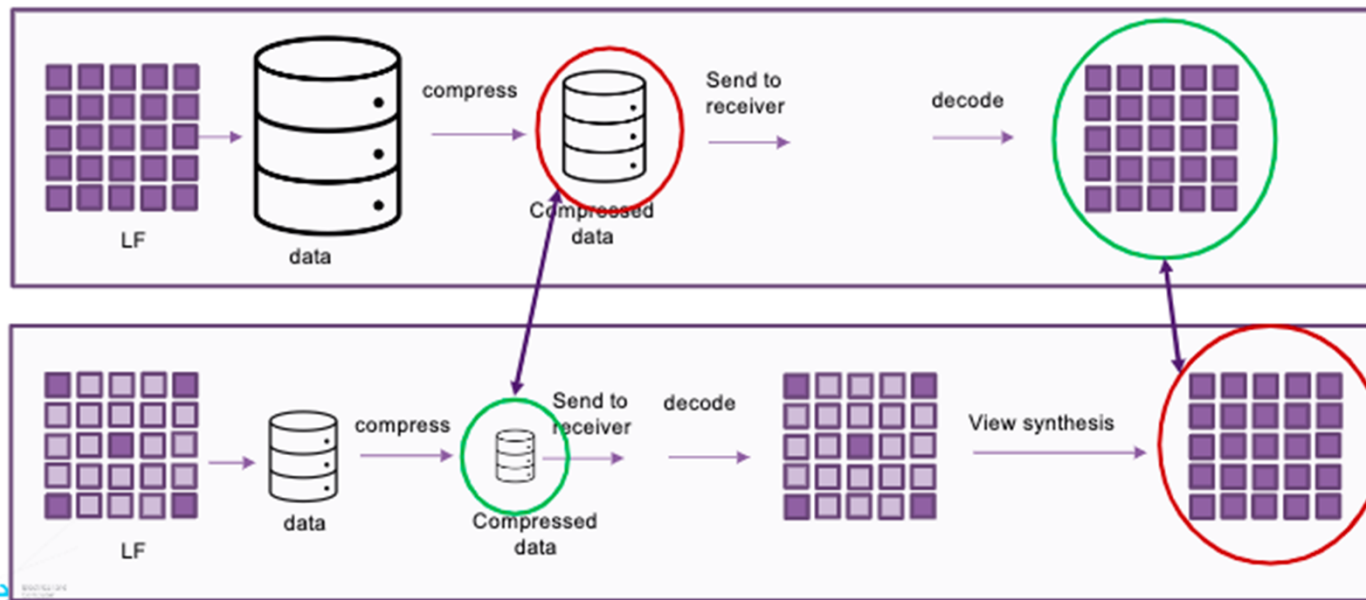
Our Proposed Solution



Different versions of input



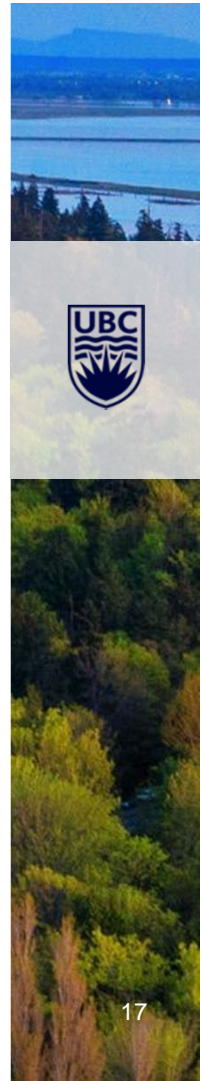
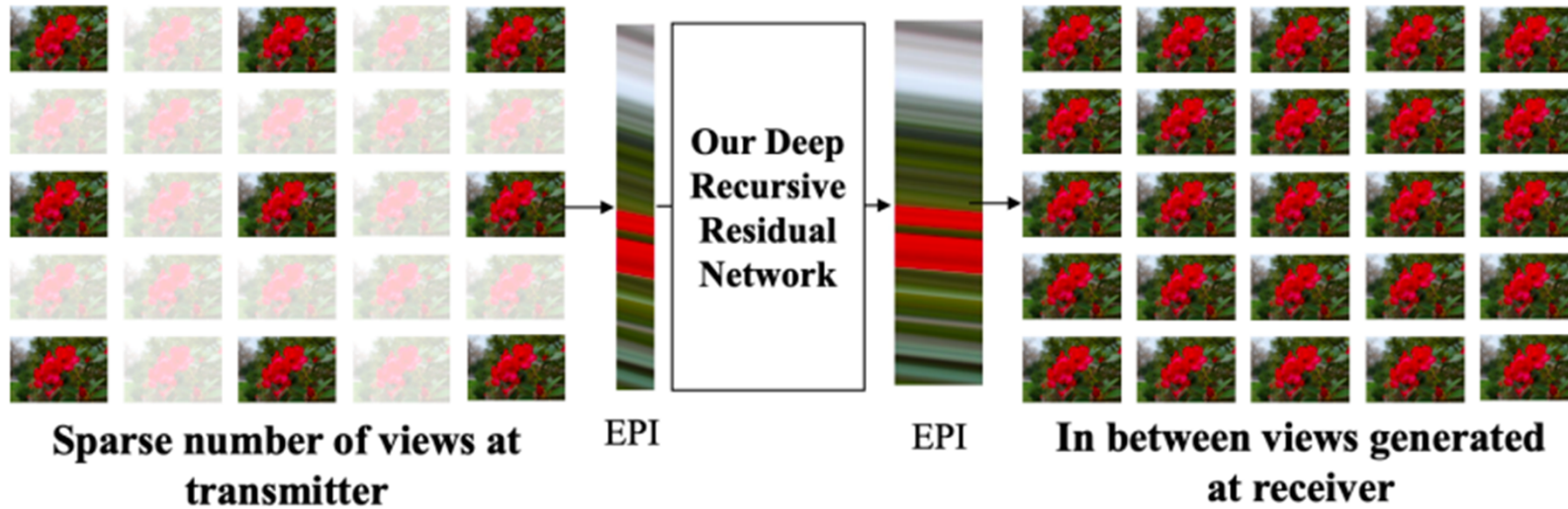
Problem Statement : Huge Amount of Data

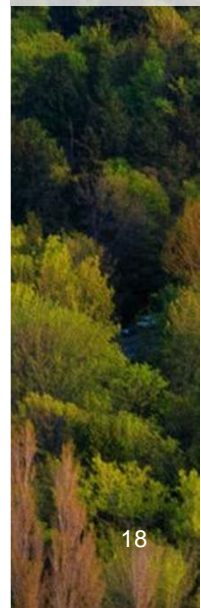
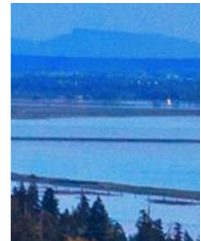
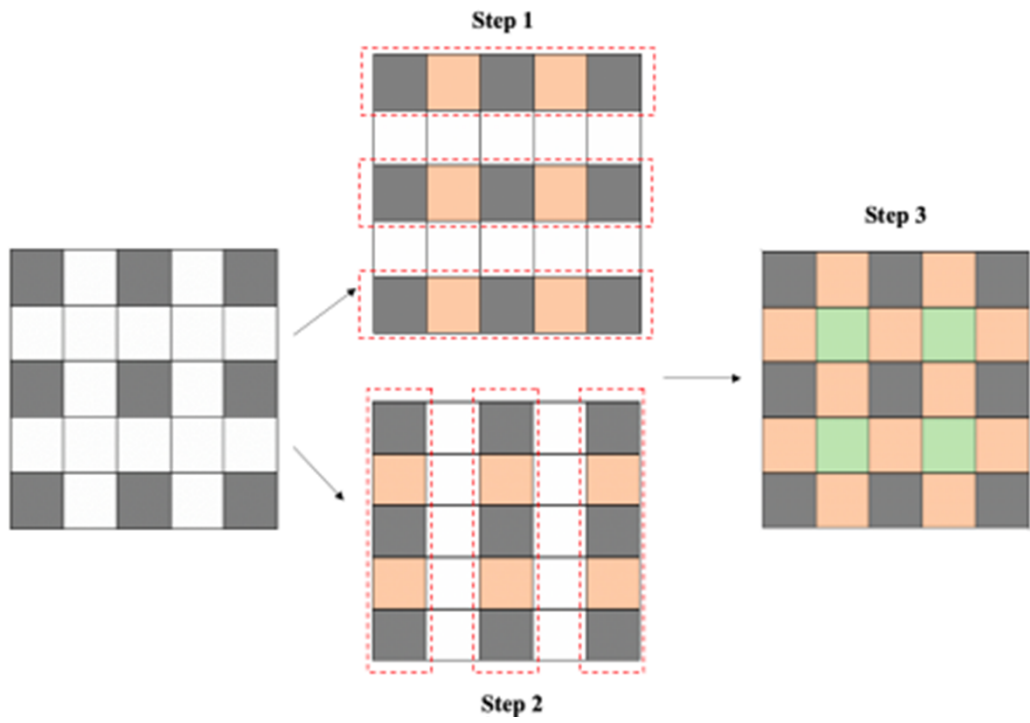


Our Proposed Solution - Choice of View Synthesis

Drop specific views at the transmitting end

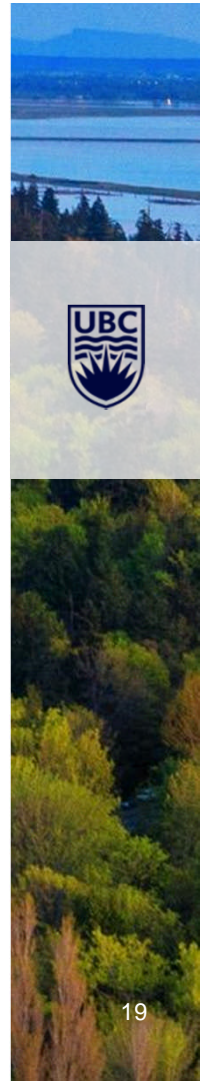
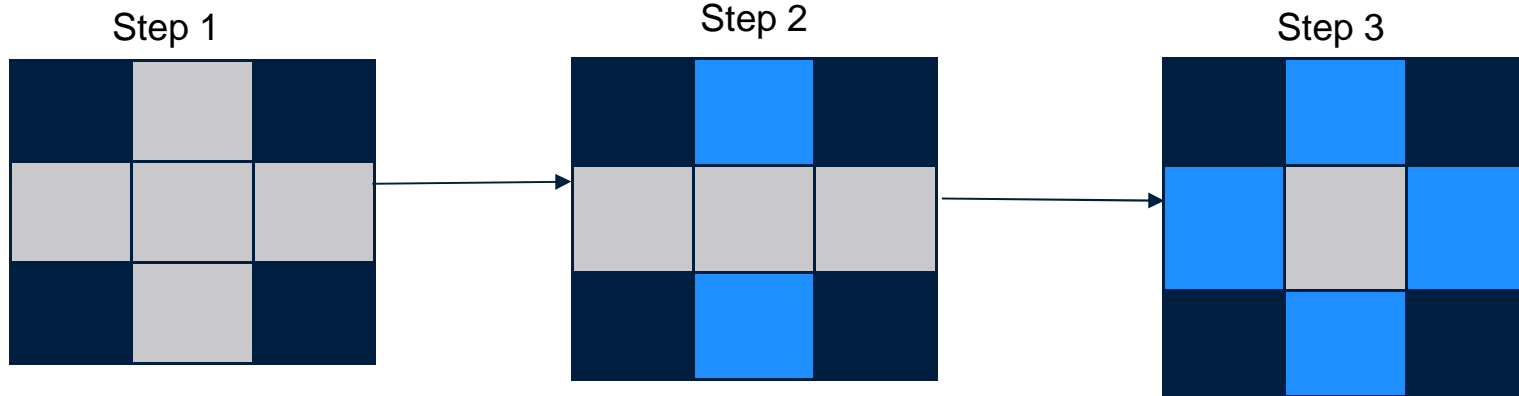
Effectively synthesize them at the receiver end



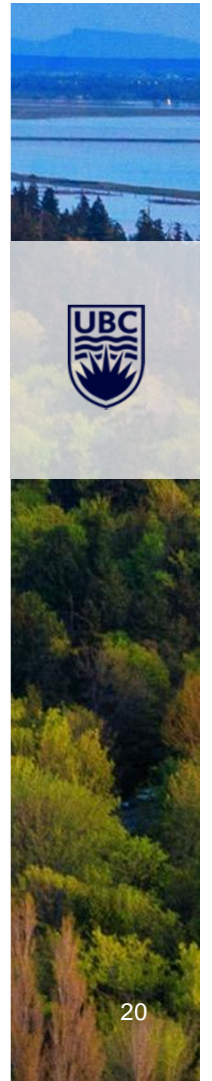
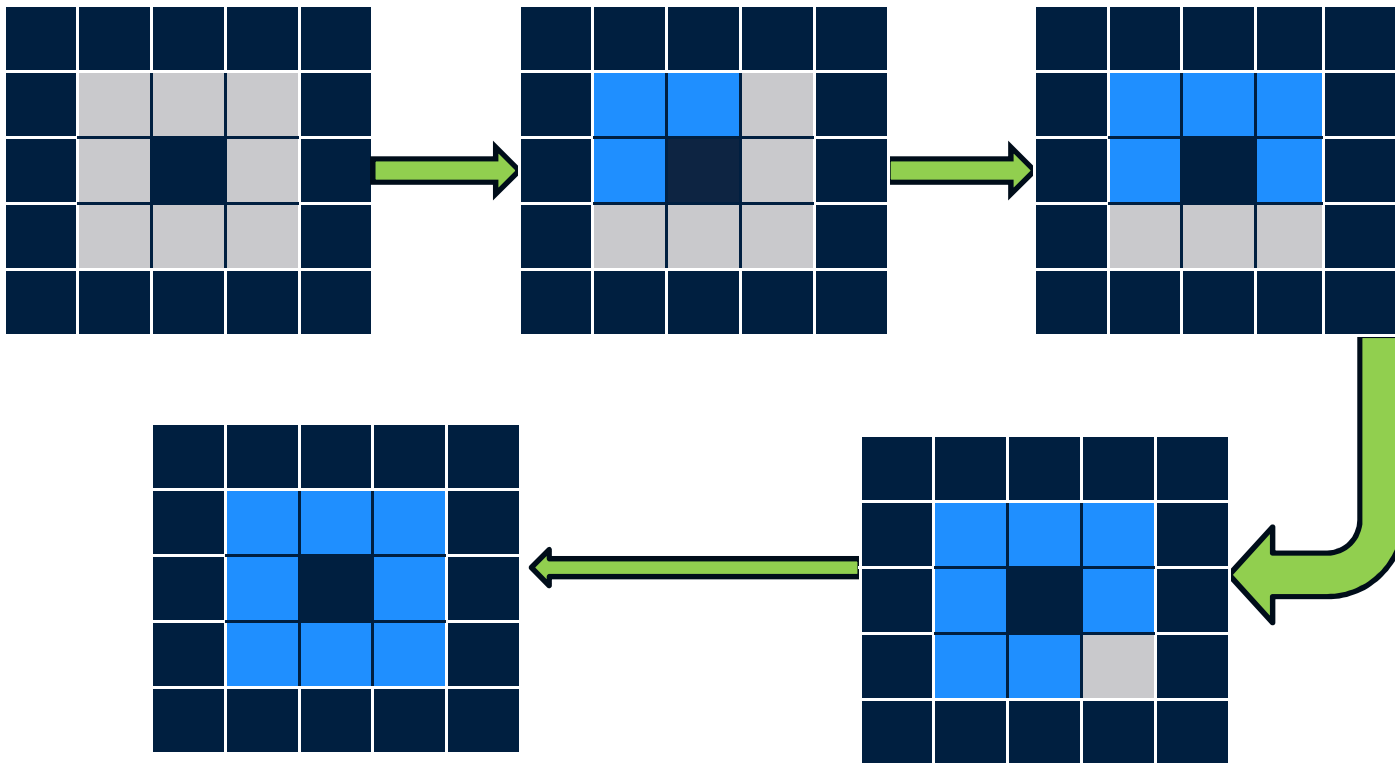


View Synthesis

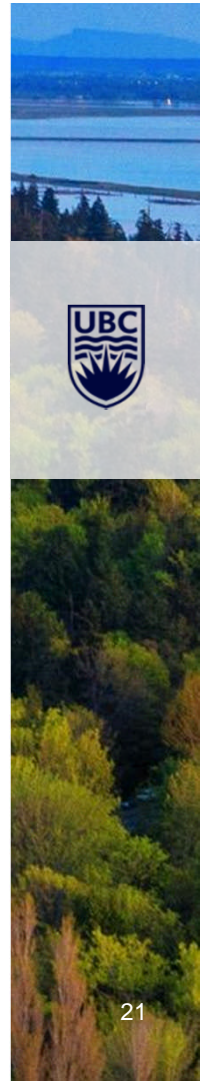
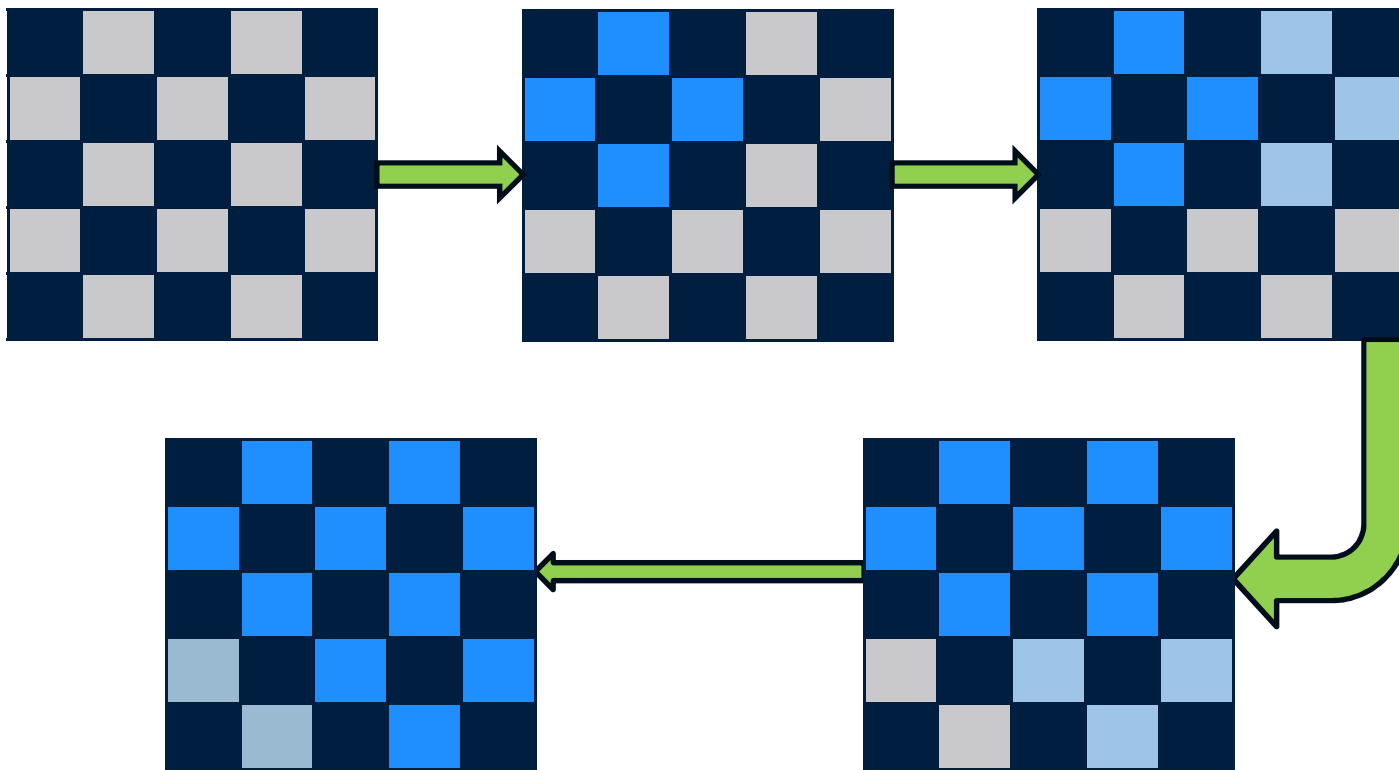
- Existing View
- Missing View
- Synthesized View



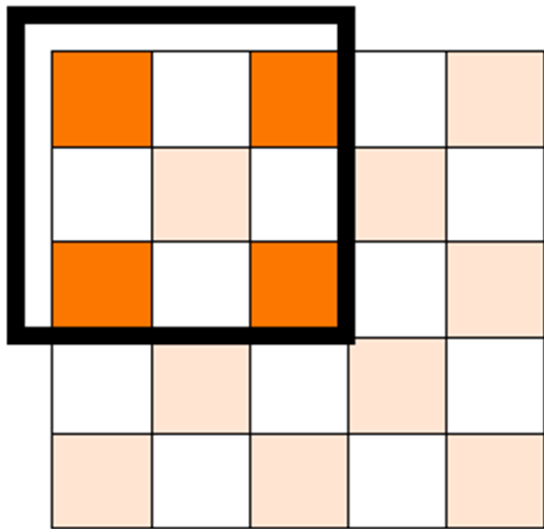
View Synthesis For Peripheral



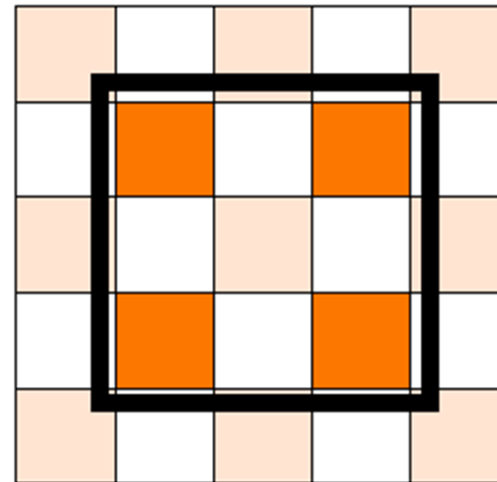
View Synthesis For Raster Skip



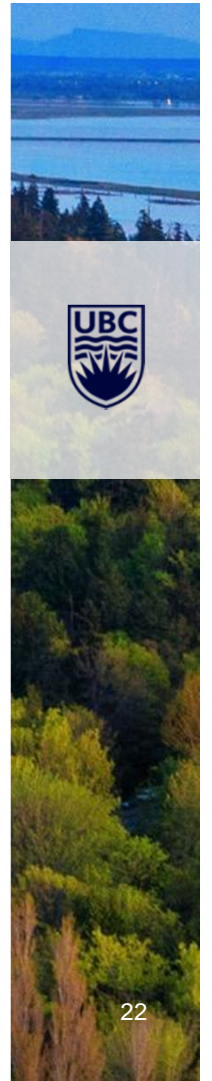
Our Proposed Solution - View Synthesis



Raster Skip Structure 1

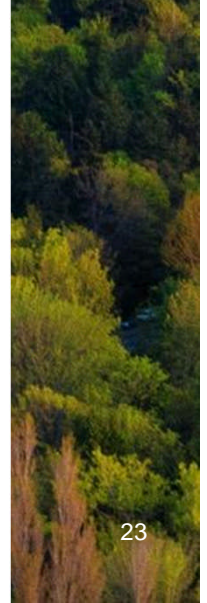
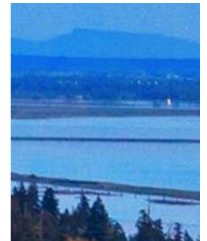
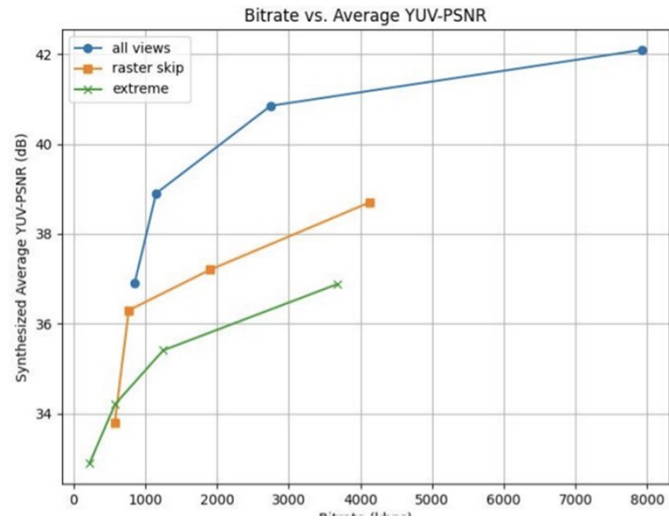
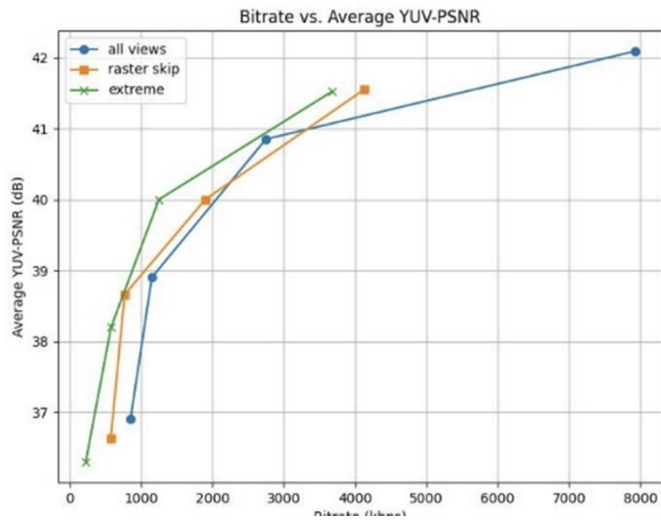


Raster Skip Structure 2

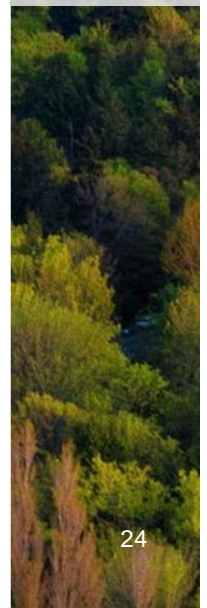
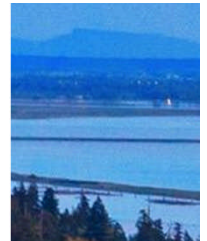
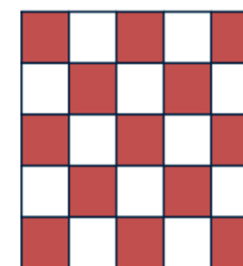
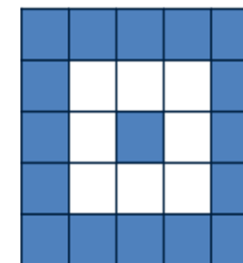
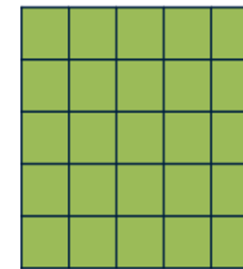
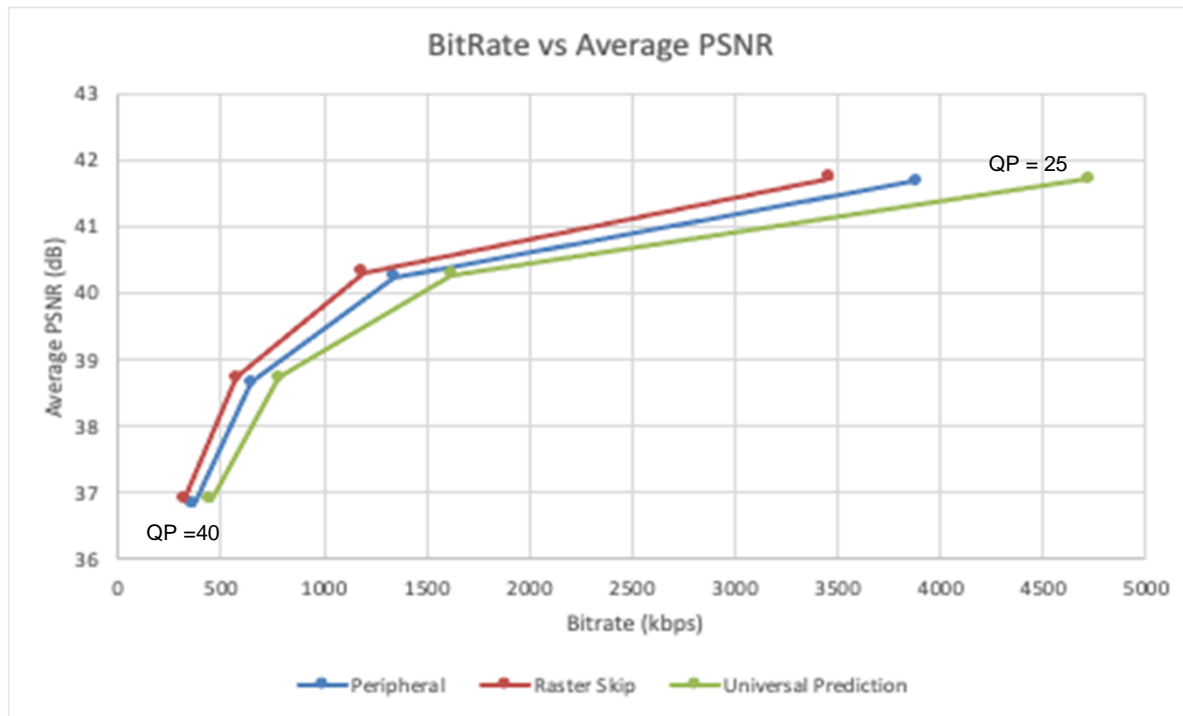


Measuring Criteria

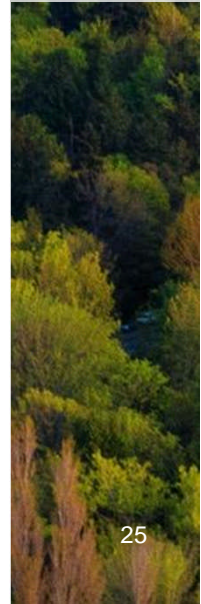
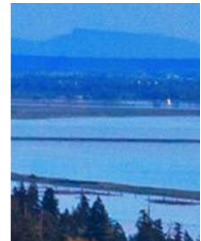
- 1. Compression Efficiency: Bitrate
- 2. Quality Data: PSNR
- 3. 4 QP Values -> 40, 35, 30, 25



Evaluation and Analysis – Compression of frames transmitted



Evaluation and Analysis - View Synthesis



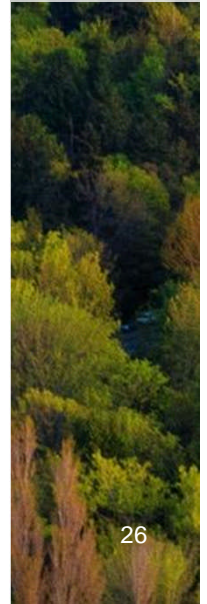
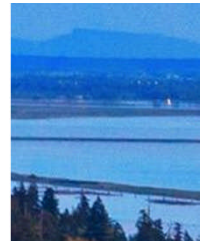
Evaluation and Analysis - View Synthesis



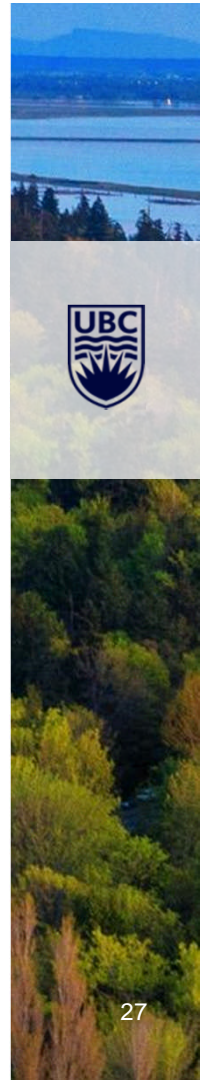
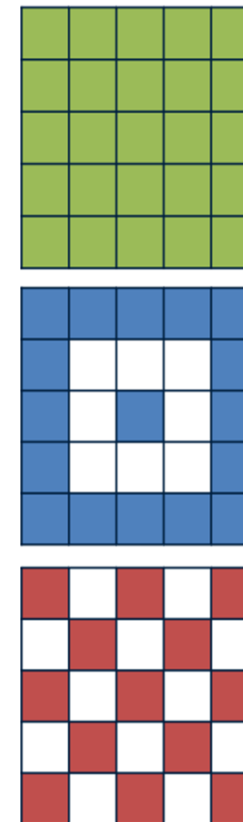
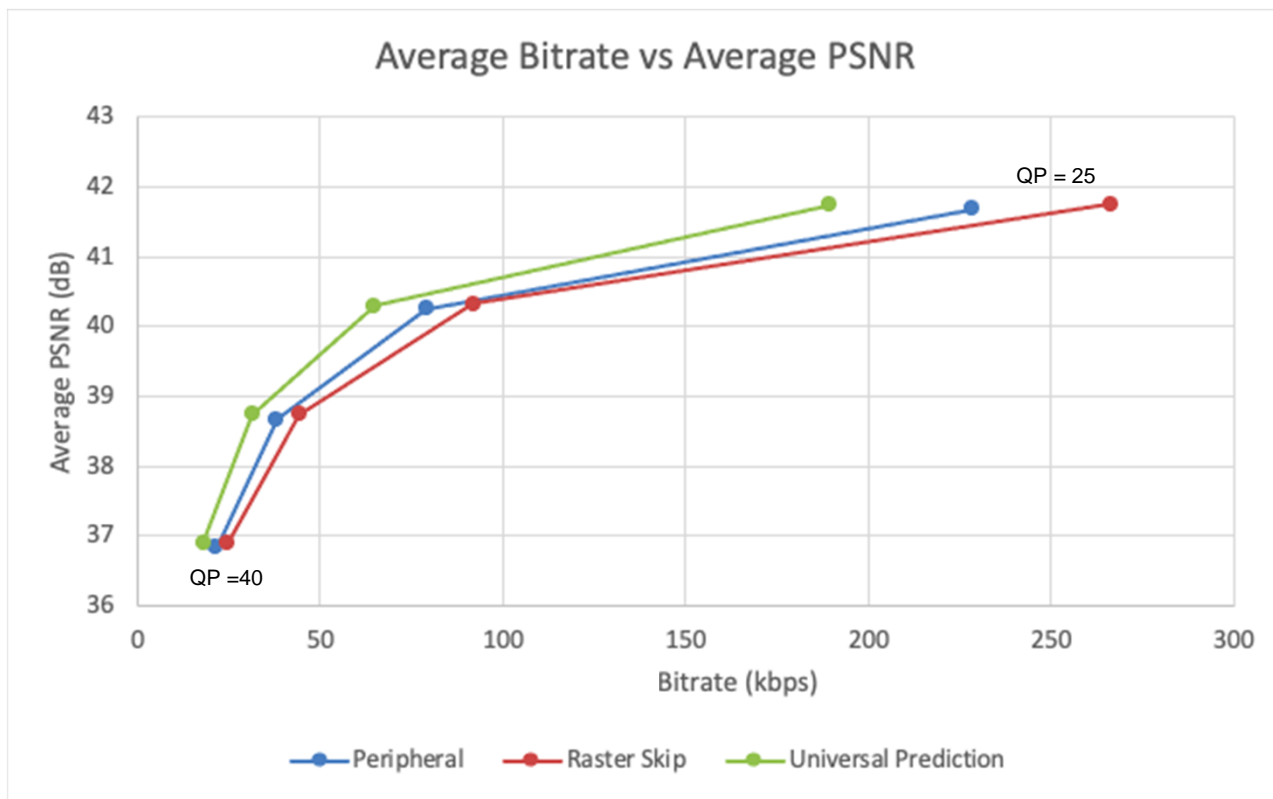
Synthesized View



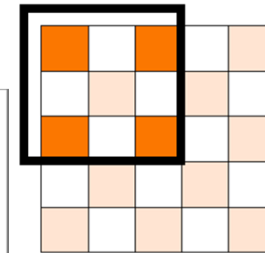
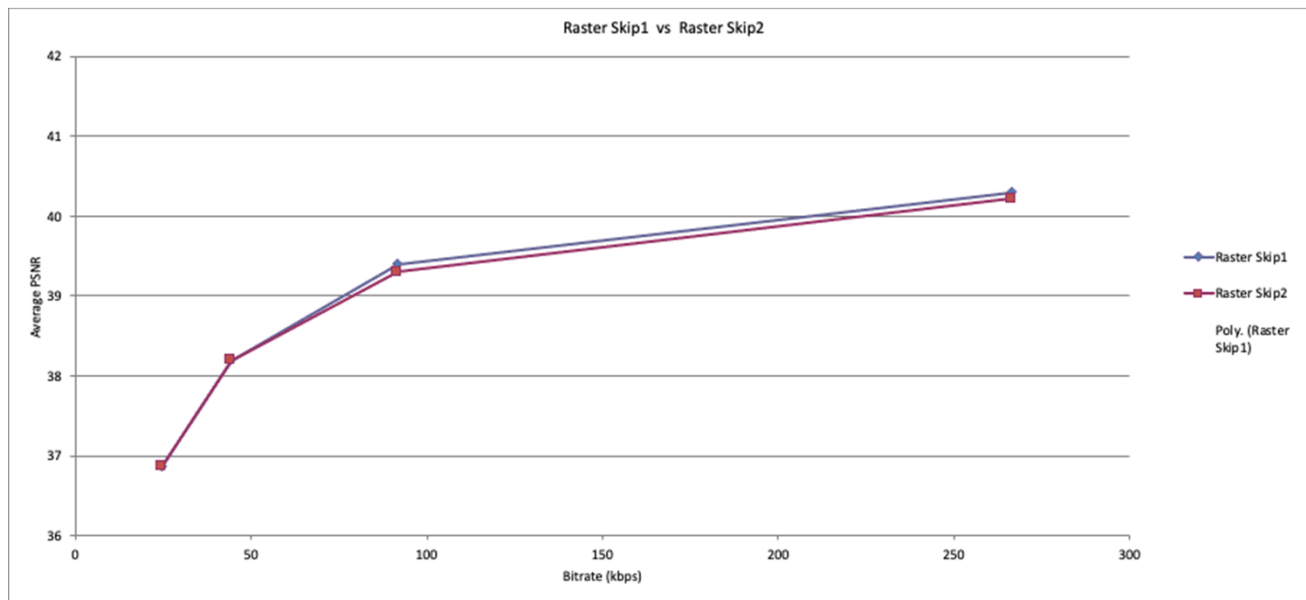
Original View



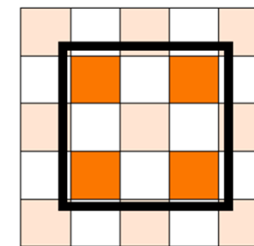
Evaluation and Analysis – Transmitted & Synthesized frames



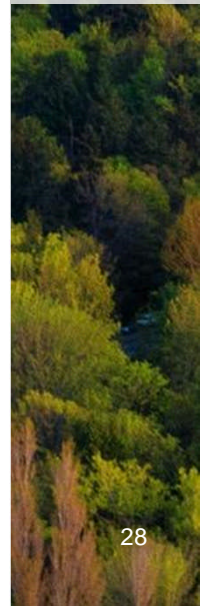
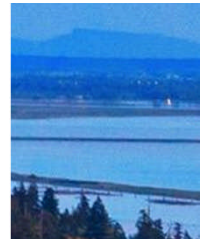
Evaluation and Analysis - View Synthesis



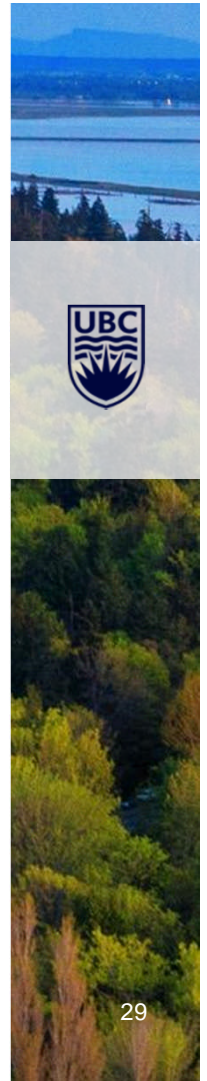
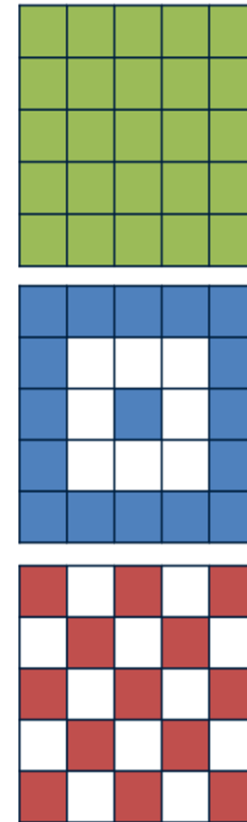
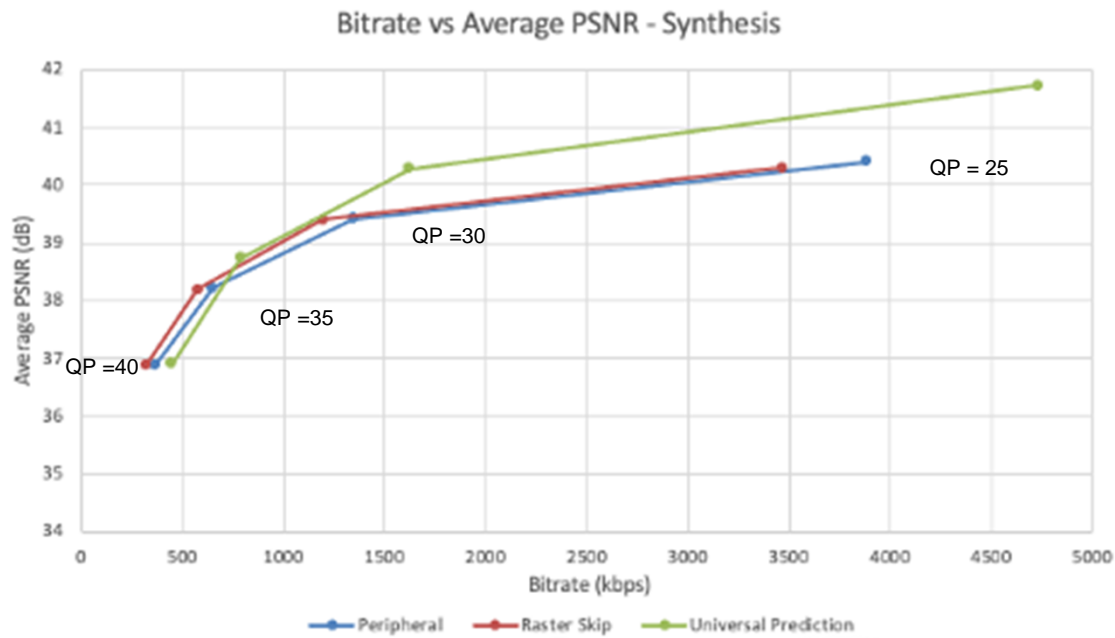
Raster Skip Structure 1



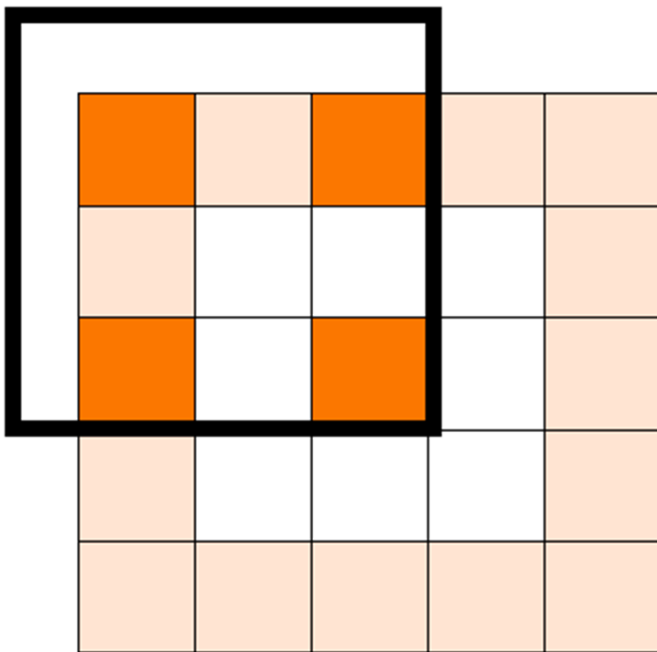
Raster Skip Structure 2



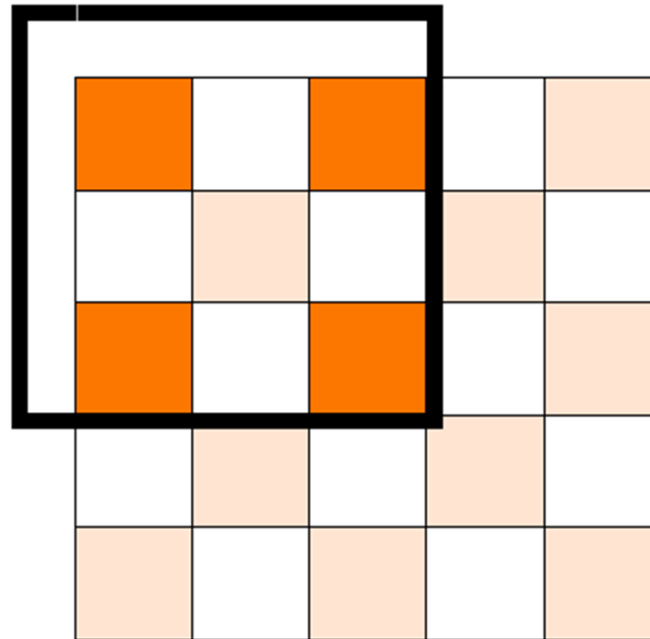
Evaluation and Analysis - View Synthesis



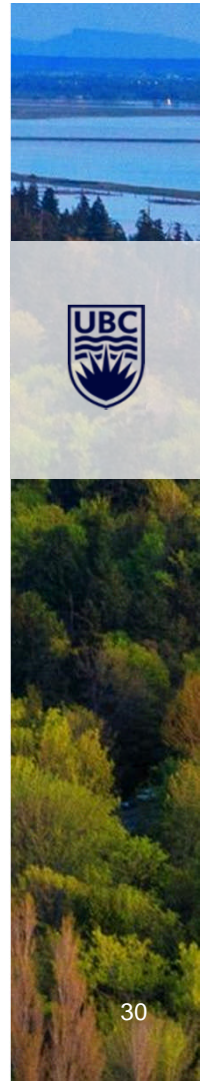
Conclusions - Compression



Peripheral Structure

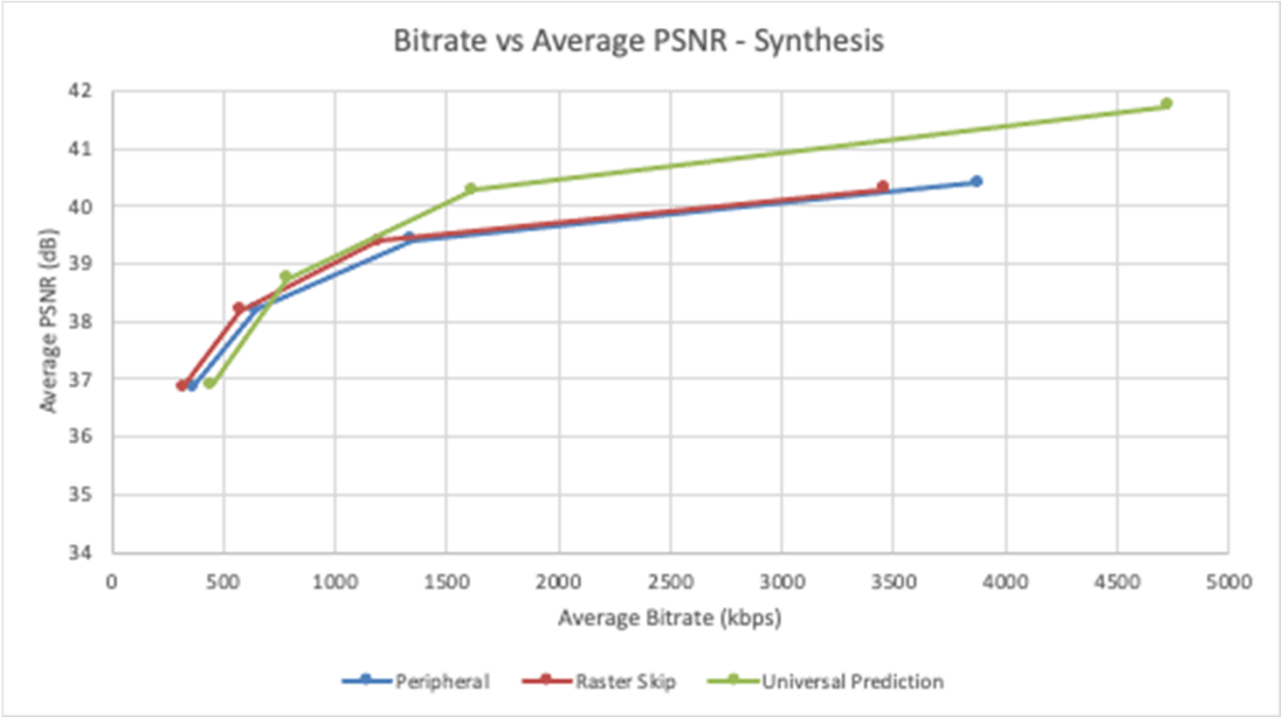


Raster Skip Structure





Conclusions - View Synthesis



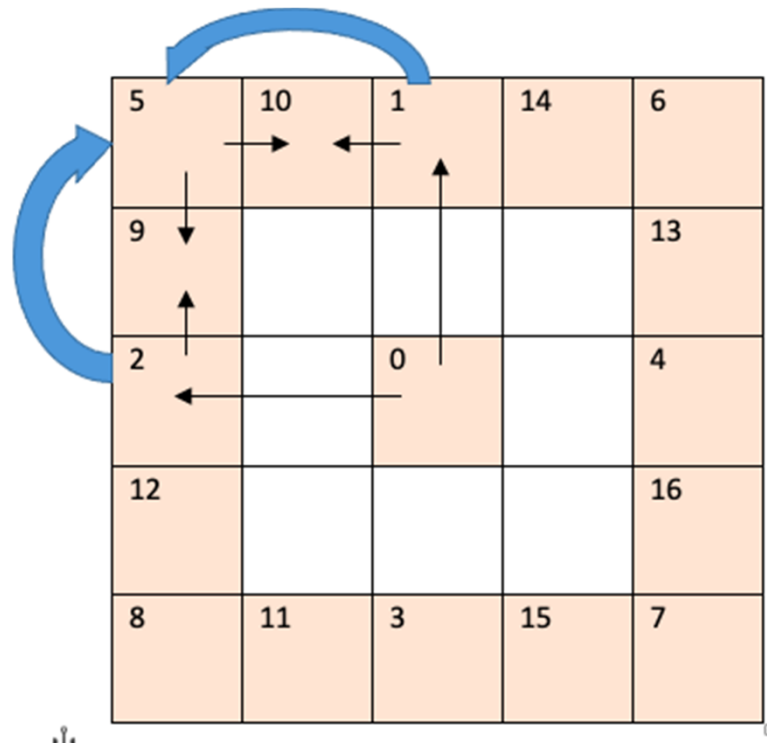
Thank you

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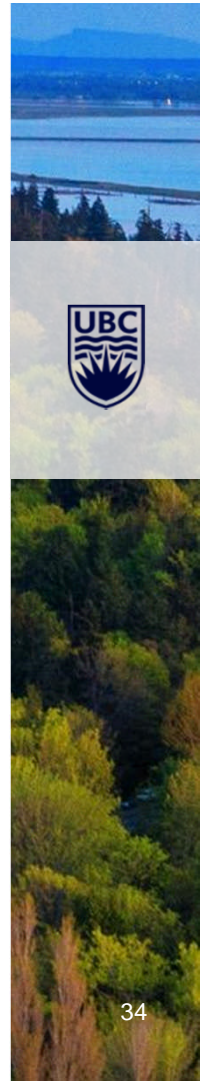


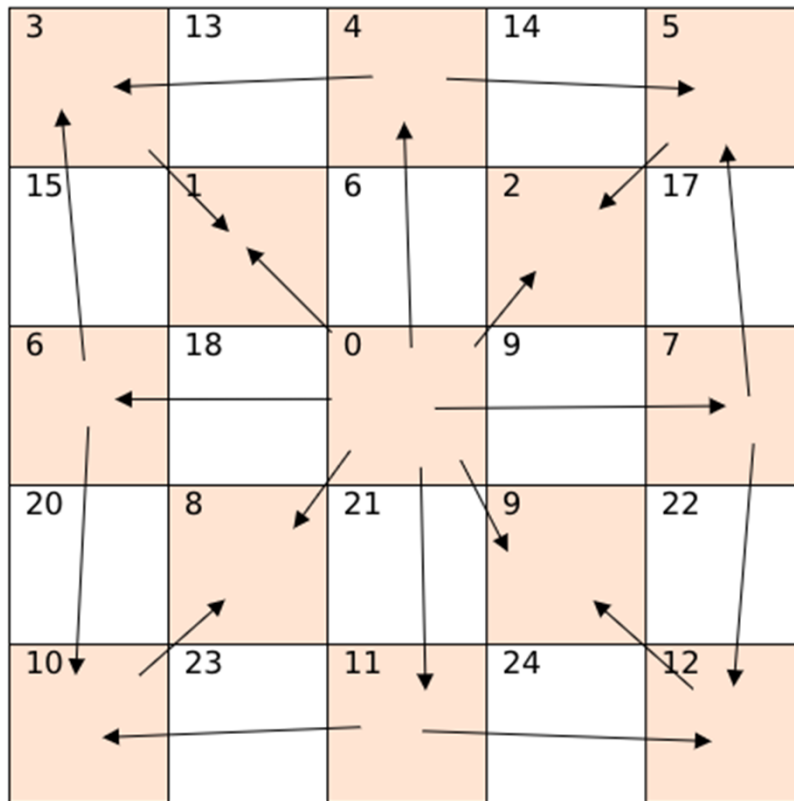
Appendix



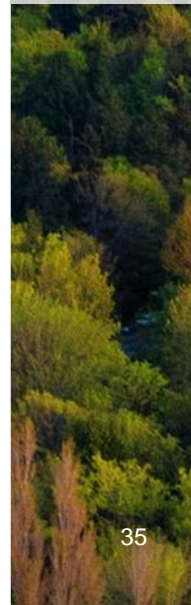
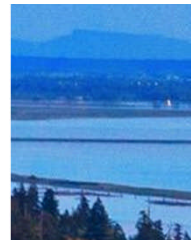


Peripheral

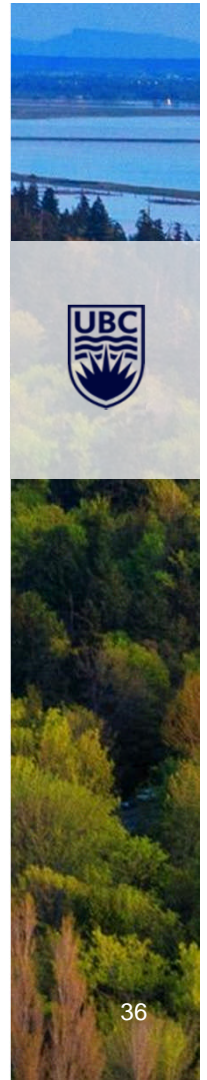




Raster Skip

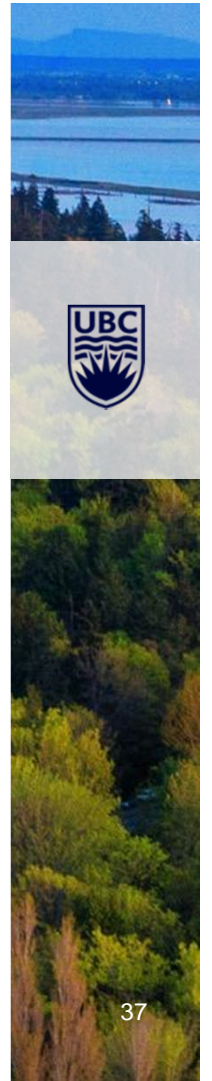


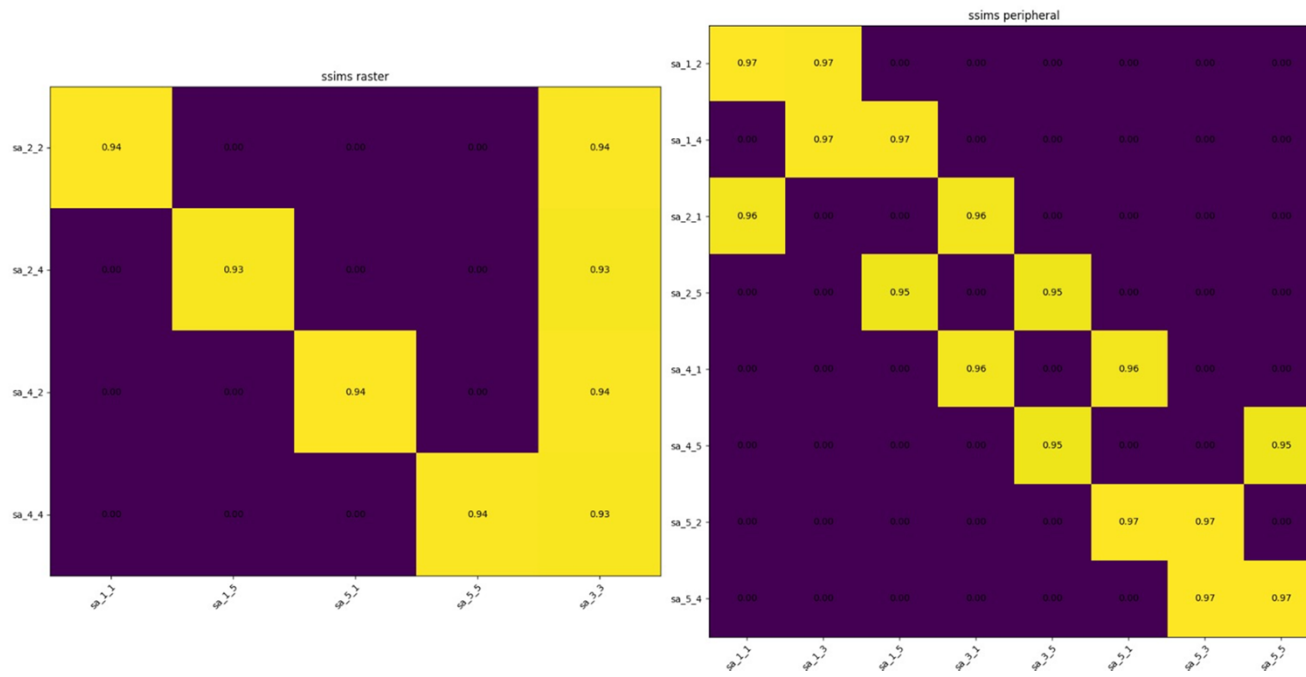
```
def rgb_to_yuv(rgb):  
    # Conversion matrix from RGB to YUV  
    m = np.array([  
        [0.299, 0.587, 0.114],  
        [-0.147, -0.289, 0.436],  
        [0.615, -0.515, -0.100]  
    ])  
  
    # Ensure the RGB values are in the range [0, 1]  
    rgb_normalized = rgb / 255.0  
  
    # Apply the matrix transformation  
    yuv = np.dot(rgb_normalized, m.T)  
    yuv = (yuv * 255).astype(np.uint8)  
    return yuv
```



```
def PSNR(original, compressed):
    mse = np.mean((original - compressed) ** 2)
    if(mse == 0): # MSE is zero means no noise is present in the signal .
        # Therefore PSNR have no importance.
        return 100
    max_pixel = 255.0
    psnr = 20 * log10(max_pixel / sqrt(mse))
    return psnr
```

Code for Calculating PSNR





SSIM Comaprision

