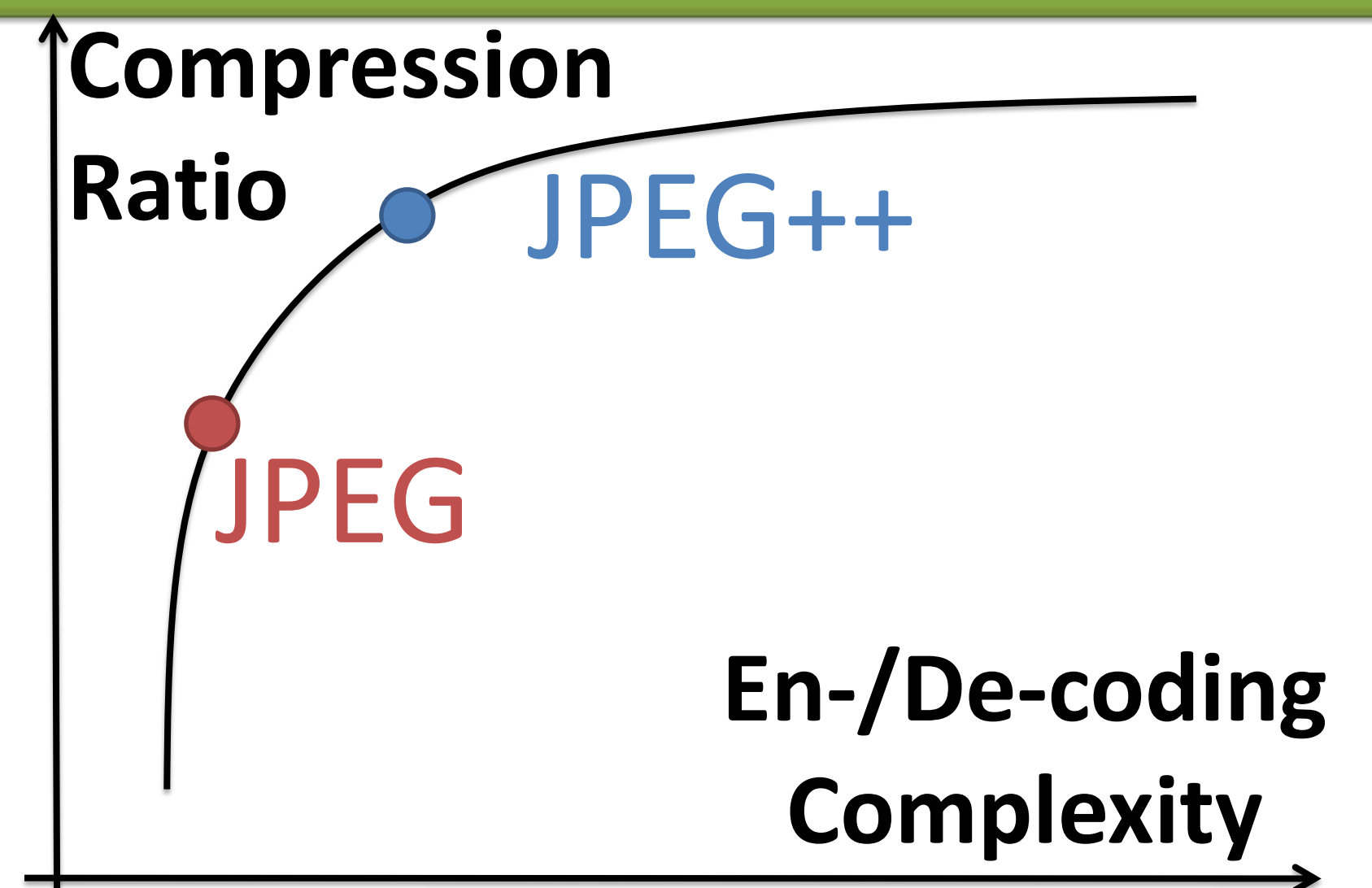


# JPEG Compression: Taking the Mickey out of the Photos

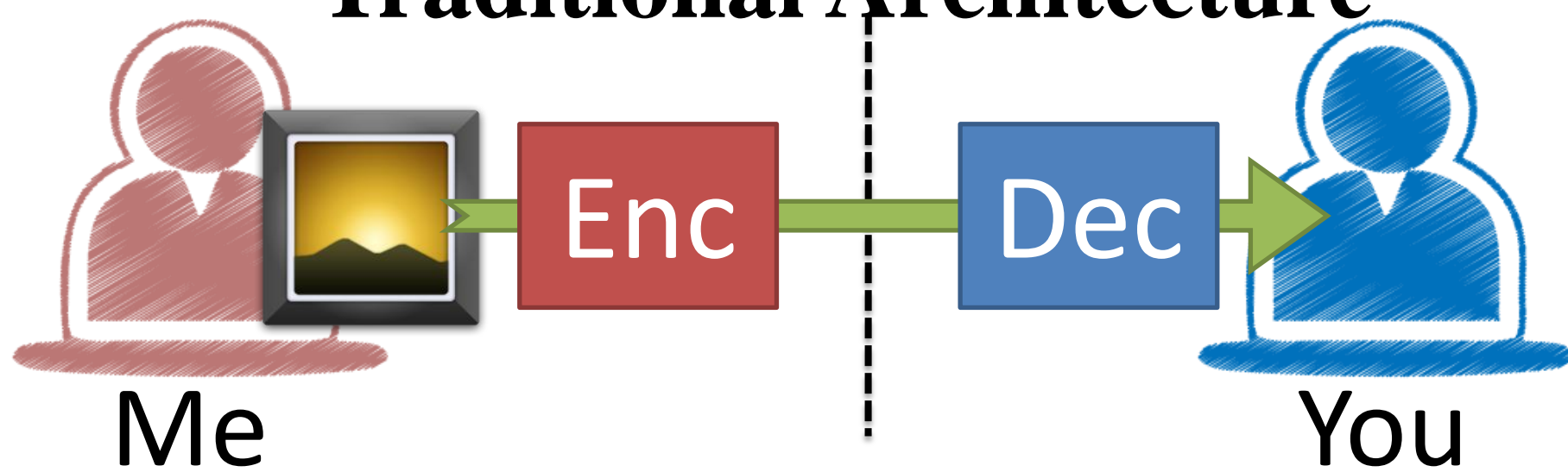
Xing Xu, Zahaib Akhtar, Wyatt Lloyd, Antonio Ortega, Ramesh Govindan  
University of Southern California

## A New Image Compression Architecture

- Most of images we see are compressed ones, because compressed images are much smaller
- Compression-Complexity **tradeoff** curve (right):
  - “good” compression requires “higher” complexity
- People prefer different points on such tradeoff curve
  - **JPEG**: we all love JPEGs, for its
    - 1) decent compression 2) low complexity
  - **JPEG++**: we can achieve better compression, just pay more complexity

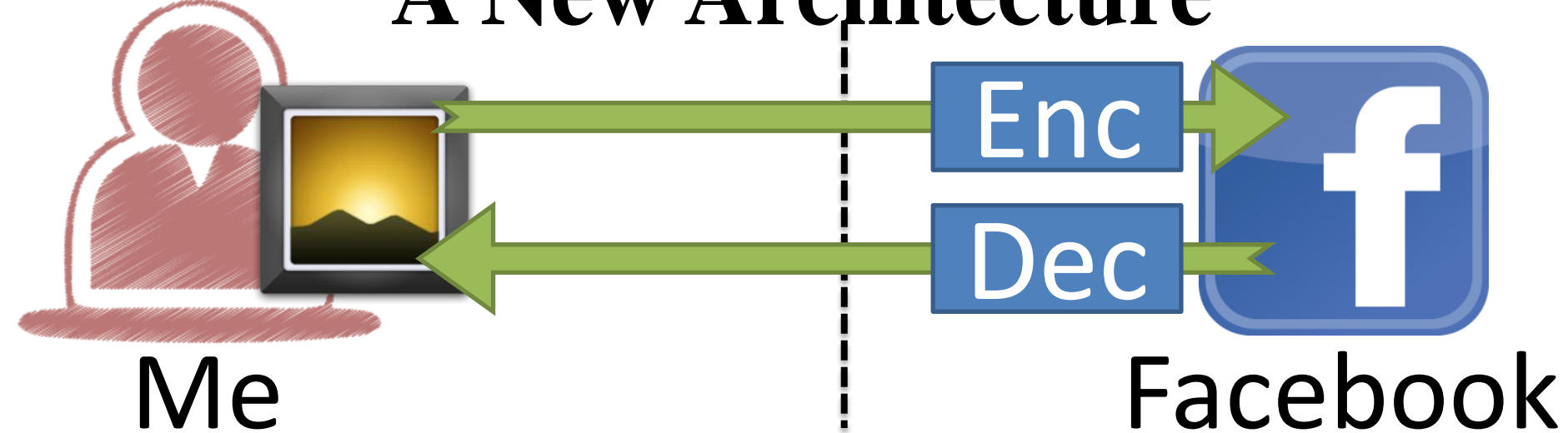


### Traditional Architecture



- I want to send a image to you, what do I do?
- 1) I compress image to JPEG (“Enc”: encoding) and send to you
- 2) You de-compress the image (“Dec”: decoding)
- **WHY? We all love JPEG!**

### A New Architecture



- I want to store image in Facebook...
- But WAIT, does FB also love **JPEG** as you do?
- **NO! FB loves JPEG++, why?**
- 1) FB stores **SO MANY** images, it desperately **prefers smaller images** (better compression)
- 2) FB has good machines, OK to pay **extra complexity**

### • A New Image Compression Architecture

- When you upload an image, FB **encodes** it to another format (**JPEG++**) with better compression
- When you download an image, FB **decodes** it to original image (**JPEG**) and returns to you

## Compress JPEG? A Lossless JPEG Encoder – Context Sensitive Entropy Coder

- We further compress JPEGs as follows:
  - 1) separate JPEG bits into different contexts
  - 2) learn common information of each context
  - 3) encode each context separately
- Why we are better than JPEG?
  - 1) JPEG only has 1 context, we have thousands...
  - 2) We carefully define “context” to make sure different contexts should be coded differently, which means that “separation is better”
- A Context Sample:
  - *Context Definition*: we observe high energy level for nearby pixels
  - *Context Expectation*: we expect pixels in this context should contain high energy level
  - → if nearby pixels contain high energy level, I know current pixel should contain high energy level with high probability
- Why? **Correlation between nearby pixels**

- Our lossless encoder can make JPEGs
- **15% smaller in 40 milliseconds** (for images of 1200x1200 resolution)

## Further Compression? A Lossy JPEG Encoder – Quality Preserving Thresholding

We propose a method that **removes some of JPEG coefficients** to make the file smaller;  
We carefully select such coefficients to make sure the modified image **quality is similar to original ones**;

- This method itself can make JPEGs 8% smaller for unnoticeable quality degradation

## Other Contributions

- We study where should we put our encoder/decoder to Facebook to maximize the benefits;
- Potentially, besides storage space saving, there are collateral benefits including
  - Cache space saving
  - Higher cache hit-rate
  - Lower storage costs at Datacenter
  - Lower bandwidth cost